EAST AFRICAN COMMON SERVICES ORGANIZATION

ANNUAL REPORT

OF THE

EAST AFRICAN AGRICULTURAL

AND

FISHERIES RESEARCH COUNCIL, 1961

Five Shillings - 1962

ANNUAL REPORT

OF THE

EAST AFRICAN AGRICULTURAL

AND

FISHERIES RESEARCH COUNCIL, 1961

Seventeenth Meeting of the Council, Muguga, 25th January, 1962

EAST AFRICAN AGRICULTURAL AND FISHERIES RESEARCH COUNCIL

(As at 31st December, 1961)

Chairman

Major Sir Ferdinand Cavendish-Bentinck, K.B.E., C.M.G., M.C.

Members

Appointed by the Authority, the East African Common Services Organization—

The Secretary-General.

Two vacancies.

Appointed by the Government of Tanganyika—

The Minister for Agriculture.

Chief H. M. Lugusha, C.B.E.

Appointed by the Government of Kenya—

The Minister for Agriculture, Animal Husbandry and Water Resources.

The Earl of Portsmouth.

Appointed by the Government of Uganda—

The Minister for Agriculture and Animal Industry.

Mr. H. L. Manning.

Appointed by the Government of Zanzibar—

The Minister for Agriculture.

Appointed by the Secretary of State for the Colonies—

Two representatives.

Secretary

Lieutenant-Colonel S. P. Fearon.

Office of the Council

Postal Address: P.O. Box 30005, Nairobi, Kenya.

Telephone: Nairobi 26411.

CONTENTS

PART I

PART II

APPENDIX

EAST AFRICAN COMMON SERVICES ORGANIZATION

ANNUAL REPORT OF THE EAST AFRICAN AGRICULTURAL AND FISHERIES RESEARCH COUNCIL, 1961

PART I—GENERAL REVIEW

In June, 1961, discussions were held in London to consider the future of the East Africa High Commission Services. It was agreed that the functions of the East Africa High Commission, with the exception of Defence, should be transferred to the East African Common Services Organization, which was subsequently established on 9th December, 1961, on the achievement of independence by Tanganyika. The Common Services Organization is controlled by an Authority, consisting of the principal elected Minister in each of the East African territories, which is responsible for the overall policy and direction of the Organization. The Authority is assisted by four Ministerial Committees, of which one is responsible for the Social and Research Services of the Organization. At the London discussions it was agreed that a Commission, consisting of one representative each from Kenya, Tanganyika and Uganda, and two United Kingdom experts (of whom one would act as chairman) should be appointed to advise the East African Governments on the most suitable structure for the management, direction and financing of research on an East African basis. The terms of reference of the Commission were subsequently extended, with the agreement of the East African Governments, to include advice to the British Government on the future management and financing of the Tropical Pesticides Research Institute at Arusha, Tanganyika.

The Commission, under the Chairmanship of Professor A. C. Frazer, M.D., D.Sc., F.R.C.P., met in Nairobi on 26th September, and after visiting the three East African territories and Zanzibar, dispersed on 20th October. Its report was published on 4th December, and is still under consideration by the British and East African Governments.

Among its many conclusions, the Commission has recommended that the present Agricultural and Fisheries Research Council should be replaced by a Natural Resources Research Council, which would be a statutory corporate body appointed by the Authority, and would consist of an independent lay Chairman, resident in East Africa, and ten to twelve other independent members, of whom not more than two should be laymen, the remainder being scientists from East Africa and overseas. If this recommendation is accepted by the Governments this, the seventh report of the Council, will be its last; and accordingly reference has been made in it to the seventeenth meeting of the Council which took place on 25th January, 1962.

Two meetings of the Council were held during 1961, the fifteenth on 13th January, and the sixteenth on 26th September, both at Muguga. Attendance at these meetings is shown in the Appendix. At the fifteenth meeting much of the time of the Council was taken up with the estimates of the research organizations for 1961/1962. The mechanical condition of the marine fisheries research vessel caused considerable concern, and the Council at this meeting confined the ship to harbour pending a full investigation of the conditions of the engines and hull by a qualified expert. The investigation was subsequently carried out, and although the R.V. *Manihine* has not been able to go to sea for the greater part of the year, the money for the necessary extensive repairs has been found, and work was proceeding on them at the end of the year.

At the same meeting the Council considered the programme for the participation of the E.A. Marine Fisheries Research Organization in the International Indian Ocean Expedition. This was approved subject to substantial funds being made available from outside East Africa for essential extensions to the laboratory, special equipment, excess costs of additional voyages, and salaries and expenses of visiting scientists.

At its sixteenth meeting the Council dealt largely with routine matters affecting the research organizations. The Frazer Commission, referred to above, attended the afternoon session. Doubts were expressed on the effect on the staff position of the introduction of a compensation scheme for officers wishing to retire after the disappearance of the High Commission. The effect of this will not be fully known until 1962, but the Frazer Commission has made recommendations designed to counteract any wholesale departure of scientific and technical staff.

The Council also considered the possibility of providing a new vessel for the Freshwater Fishery Research Organization, but postponed this pending the receipt of new estimates, and the result of negotiations on the provision of funds. The new vessel with its essential accessories is expected to cost in the region of £18,000. In the veterinary sphere, the Council established a Standing Committee, under the chairmanship of the Director of the E.A. Veterinary Research Organization, with executive powers to co-ordinate and apply more closely the work of E.A.V.R.O. and the Kenya Government Kabete laboratories on Contagious Bovine Pleuropneumonia in the Kenya Masailands.

The seventeenth meeting of the Council, which may prove to be its last, was held at Muguga on 25th January, 1962. Under its present title the Council first met at Muguga on 3rd February, 1955, but there had been two previous meetings of its predecessor, the Governing Body for the Natural Resources Group of High Commission Research Services, in January and August, 1954. The Council noted that the only survivors of that first meeting in January, 1954, who were still actively connected with the Council, were the Chairman, Sir Ferdinand Cavendish-Bentinck, Mr. H. R. Binns, the Director of the E.A. Veterinary Research Organization, and Mr. D. Rhind, the Secretary for Colonial Agricultural Research,

The Council considered the estimates of the research organizations for 1962/1963, and the recommendations of the Agricultural, Forestry, Animal Industry, Veterinary, Inland Fisheries and Marine Fisheries Research Co-ordinating Committees. It also had an informal discussion on the recommendations of the Frazer Commission report, which was due to be discussed in greater detail by the Social and Research Services Ministerial Committee in February.

All the research co-ordinating committees met during the year. Four of them, the Agricultural, Animal Industry, Veterinary and Marine Fisheries Research Co-ordinating Committees met at the invitation of the Tanganyika Government at Dar es Salaam in November. The Inland Fisheries Research Co-ordinating Committee had met previously in Nairobi in October, and the Forestry Committee met later in Nairobi in December. There was no meeting of the Trypanosomiasis Research Advisory Committee which only meets once every two years, and is due to meet again in 1962. Of the ancillary specialist committees, six met in 1961—the Pasture Research Specialist Committee, the Specialist Committee on Animal Nutrition, Physiology and Breeding, the Specialist Entomological and Insecticides Committee, the Specialist Committee on Agricultural Botany, the Specialist Committee on Animal Disease Research, and the Specialist Committee on Forest Research.

Mr. B. J. Mukasa, O.B.E., Minister for Agriculture, Uganda, and Mr. Juma Aley Abrawi, Minister for Agriculture, Zanzibar, have joined the Council in the past year. Mr. Michael Blundell re-joined the Council after his election to the Legislative Council and his appointment as Minister for Agriculture in the Government of Kenya. Mr. Blundell's elevation to a Knighthood in the New Year Honours, 1962, was noted with great satisfaction by the Council.

It is necessary to record in this report two decisions of the Social and Research Services Ministerial Committee which met on 1st February, 1962. The first was a recommendation (subsequently approved by the Authority) to wind up the East African Marine Fisheries Research Organization as quickly and economically as possible. This decision was taken in the light of the prevailing financial situation, and because no immediate economic advantages could be seen in continuing the work of the Organization it was considered that the money required for its maintenance could be more profitably used for other research efforts.

The second decision of the Ministerial Committee was that the Tropical Pesticides Research Institute at Arusha should be administered by the East African Common Services Organization as soon as satisfactory financial arrangements could be agreed with the British Government, and that its future research work should become the responsibility of the new Natural Resources Research Council.

The reports which follow in Part II are abbreviated versions of the technical and scientific annual reports published separately by each organization. They are written as far as is possible in non-technical language and are designed chiefly to provide the layman with as much information as he will require on the activities of the research organizations. Visits to the laboratories can be arranged in consultation with the Directors who are always very pleased to welcome members of the public.

PART II—THE REPORTS OF THE ORGANIZATIONS

THE EAST AFRICAN AGRICULTURE AND FORESTRY RESEARCH ORGANIZATION

DIRECTOR: E. W. RUSSELL, C.M.G., M.A., PH.D.

The principal lines of work as described in the Research Council's Report for 1960 have all been continued. The staffing position has remained good. We have only lost one member of the research staff, Dr. H. C. Pereira, Deputy Director and Head of the Physics Division, who left at the end of May to become Director of the Agricultural Research Council of Rhodesia and Nyasaland. His place as Deputy Director was taken by Dr. W. J. A. Payne, Head of the Animal Husbandry Division; and Dr. J. S. G. McCulloch has been promoted Head of the Physics Division. A new physicist to fill the vacancy in that Division has not yet been appointed. Otherwise there have only been two vacancies on the research staff for which there have been no applicants during the year. The Scientific Assistant establishment has been effectively full all the year, five having retired, of which one was supernumerary, and four new ones being appointed.

A serious attempt is being made to recruit or train Africans for some of the more senior posts in this Organization. A Makerere student who will be taking his final examinations in March has been conditionally offered the post of plant breeder in the Sorghum Breeding Research Division, and if he obtains a good degree will probably be sent to Reading University for post graduate training. M. Njoroge joined the staff of the Animal Husbandry Division in November as biochemical assistant, and two members of the laboratory assistant staff, P. N. Nganga and E. W. Wareru, have been promoted to the "D" (Training) grade for training as statistical assistants. The Director of the E.A. Statistical Department has kindly allowed them to attend the courses he has arranged for members of his own Department. It is hoped that suitable courses for other members of our laboratory assistant and clerical grades can be arranged in the near future so that some more officers can be promoted into the Training grade.

HONOURS

Mr. Mayda Kapitapa, the Farm Overseer was awarded a Queen's Certificate and Badge of Honour in the Birthday Honours, in recognition of his long and loyal services to this Organization and its predecessor the E.A. Agricultural Research Institute.

BENEFACTIONS

It is again gratifying to report that we continue to receive help from Foundations. This year the Munitalp Foundation provided the money for a Mobile Meteorological Laboratory for the joint use of the Physics Division, E.A.A.F.R.O. and the E.A. Meteorological Department as well as some additional radiation equipment needed for the research programmes of the Physics Division. All the equipment needed for it has been ordered, and it is hoped that it will be ready for use early in 1962. The Foundation has also generously given a Research Fellowship for an Agricultural Meteorologist to work in this Laboratory, and it is gratifying to note that several very suitable meteorologists applied for the post. It is hoped that the applicant appointed will arrive at about the same time as the Laboratory is completed.

VISITING SCIENTISTS

We have had only one visiting scientist working for any length of time this year. He was Dr. M. D. Gwynne, a Nuffield Research Fellow from the Botany Department of Oxford University, who arrived last year and completed his twelve months' work in our Plant Physiology Division in September. In addition five research workers, four of whom were from other parts of Africa, paid extended visits to the Physics Division, to study and familiarize themselves with some of the techniques we have developed.

CONFERENCES AND COMMITTEES

The Director was Chairman of the 1st Inter-African Hydrology Conference organized by the Commission for Technical Co-operation in Africa South of the Sahara (C.C.T.A.) held in Nairobi from 16th to 25th January. This was attended by all members of the Physics Division, who contributed very extensively to the discussions, and staged a very fine exhibition of their hydrological work. He was also Chairman of a Symposium on the Organization of Agricultural Research in Africa, which was organized by C.C.T.A. and held at Muguga from 11th to 15th December. He was a member of a Mission appointed by the Governor of Mauritius to report on the future of the tea industry in that Island. He attended a Conference of Directors and Senior Officers of Overseas Departments of Agricultural Institutions held at Wye in September. He organized and was Chairman of a Conference on Problems of Managing Land in Areas containing both Cattle and Game, which was held at Lake Manyara in February. He was Chairman of the Conference of the Senior Soil Chemists held at Muguga in May; of a Conference on some problems of managing semi-arid lands, also held at Muguga in May, at which Dr. Pereira and his colleagues were asked to summarize some of the more important applications of their work in this field; and of the pasture Research Committee which was held at Makerere in October.

The Director is a member of the E.A. Agricultural, Animal Industry, and Forestry Research Co-ordinating Committees, the Kenya Agricultural and Veterinary Research Advisory Committee, the Kenya Pasture Research Advisory Committee, the Research Committee of the Kenya Coffee Board and of the Kenya and Tanganyika Sisal Research Committees, the Kenya National Dairy Committee, and of the Research Advisory Committee of the Ngorongoro Conservation Authority. He is a member of the Governing Body of the Tea Research Institute of East Africa, and Chairman of its Research Committee; a member of the Namulonge Advisory Board of the Empire Cotton Growing Corporation; a member of the Scientific Council for Africa South of the Sahara (C.S.A.), and attended its 12th Meeting at Pointe Noire in August; and is a member of the Agricultural Research Council of Rhodesia and Nyasaland.

Dr. H. H. Storey is a member of the East African Medical Research Council and of the East African Industrial Research Board, and a Trustee of the Coryndon Museum. He is Chairman of the Specialist Committee on Agricultural Botany, which met at Makerere in September, and Chairman of the East African Standing Technical Committee on Plant Import and Export, of which Dr. F. M. L. Sheffield is also a member, and Mr. P. J. Dickinson of the E.A. Plant Quarantine Station is Secretary.

Dr. Sheffield attended the 6th Annual Meeting of the Inter-African Phytosanitary Commission held at Ibadan, and was leader of the U.K. delegation as well as being the East African representative.

Dr. W. J. A. Payne attended the 8th International Congress of Animal Production held in June at Hamburg, at which he presented several papers on the Division's work. He has been invited by F.A.O. to serve as a member of a World

Panel of Experts on Animal Nutrition Problems, and attended a meeting of the F.A.O. Animal Nutrition Panel in October in Washington, at which he also attended a meeting of representatives of the World Animal Production Associations. He is a member of the Kenya Pasture Research Advisory Committee and, with Dr. H. G. Livingston, a member of the Research Advisory Committee of the Kenya Pig Industry Board.

Dr. A. L. Griffith attended the Thirteenth Congress of the International Union of Forest Research Organizations in Vienna in September and was appointed a member of their International Committee. He is a member of the East African Timber Advisory Board, Chairman of the Specialist Committee on Forestry Research, and a member of the Planning Committee for the forthcoming Commonwealth Forestry Conference. Mr. W. Wilkinson attended a Symposium on Insect Polymorphism in London, and also the 4th International Congress of the International Union for the Study of Social Insects in Pavia, at which he presented some of the work of the Forest Entomology Division. Both he and Mr. T. Jones attended the East African Timber Advisory Board meeting, and Mr. Jones attended the meeting of the Specialist Entomological and Insecticidal Committee at Mwanza.

Dr. J. S. G. McCulloch attended a Radiation Symposium convened by W.M.O. in Vienna. Mr. H. Doggett was invited to attend and address the Seed Improvement Seminar sponsored by the International Co-operation Administration in Nairobi in June. Dr. H. F. Birch served on the Kenya Wheat Baking Quality Committee.

Physics Division

Water Use and Water Conservation

The Physics Division is concerned with helping the territories and the farmers make the very best use of the rain that falls in East Africa. One section of the work deals with the effect of different methods of using land in the high rainfall areas on the evenness of flow of the rivers arising in them; for it is of great importance that the rivers flood as little as possible in the rains and maintain as large a flow as possible in the dry season. The Division has been co-operating with a number of departments in all three territories, including forestry, agriculture, water development and hydrology, in helping to run a series of catchment area experiments situated in such areas. These experiments consist in comparing the water use by different permanent crops, such as bamboo forest, natural high forest, planted softwoods, tea plantations, and, in addition, peasant cultivation, on the flow of water in the rivers which originate in these catchments. The experiments are now in their fourth or fifth year, and the results of the first three years have been collated and written up for publication. The territorial governments have agreed to help finance a special number of the E.A. Agricultural and Forestry Journal in which are being printed not only the papers that the E.A.A.F.R.O. staff were responsible for, but also other papers on these experiments which have been contributed by some of the territorial workers who have been involved in them.

The following results of practical importance have come out of these experiments:

(1) Natural forest trees growing on deep soils in areas where there is a pronounced dry season can dry the soil to depths of 15 ft. to 20 ft. without suffering severely from the drought. Hence when the rains start after a drought, a very appreciable amount must fall before any significant proportion can enter the rivers from such undisturbed land.

(2) A young well managed pine forest uses less water in a drought than indigenous bamboo, even though the pine is growing rapidly much of the year. This is due to the fact that it takes a considerable time for the pine trees to develop as extensive and deep a root system as the indigenous bamboo, and it is probable that once the trees become mature they will start using as much or more water than bamboo.

(3) A well managed young tea estate uses less water than the natural forest it replaces, but allows rather more of a heavy storm to enter the rivers flood flow. Its effect on the river flow during the dry season has not been very serious.

(4) African cultivation on hill slopes gives very severe flash floods with a high silt content and very poor dry season river flow compared with a forested hill slope from which cattle have been excluded.

Another experiment in this series is planned to measure the effect of introducing grazing control on very seriously overgrazed land on the water available to the vegetation and on the reduction of flash flooding in an area belonging to a pastoral tribe. It has not yet been possible to arrange for the introduction of the grazing treatments, due to administrative difficulties, but the results for the uncontrolled grazings show that over much of the area the soil is rarely wet at 18 in. depth and that up to 40 per cent of the rainfall runs off as flood water. This means that instead of the area receiving just over 30 in. of rain annually, which should be just sufficient to give good grazings, under 20 in. penetrates into the soil, allowing only semi-desert scrub to develop.

The Division staged a large and very successful demonstration of these experiments and the results obtained from them at the Royal Show in Nairobi in September, and it is very pleasing to add that the Kenya Forestry Department and Ministry of Works gave us wholehearted co-operation in this project.

Water Use by Plants and Irrigation Research

Work has been continued on determining the amount of water plants use under different conditions, and these are being compared with the amounts of water evaporated from suitable pans or tanks and the amount of open water evaporation calculated by Penman's methods. Some of this work involves experiments in Muguga, some the analysis of data collected by departmental work and elsewhere, and some irrigation experiments made co-operatively with territorial workers on territorial experiment stations. Much of this work must continue for a number of years before reliable conclusions can be drawn from the experiments, though during the year the following results have been confirmed, namely, that Star grass kept short uses the same amount of water as Guinea grass allowed to grow tall; and that grazed Kikuyu grass uses the same amount of water as plantations of pine and cypress, or as a bamboo thicket when growing under comparable conditions.

Soil Cultivation

Work has continued in co-operation with the Tanganyika Department of Agriculture on the value of tie-ridging as a means of conserving water for the use of the crop in dry areas subject to fairly heavy rainstorms. This year the drought was so severe that the maize growing on the land that was not tie-ridged formed no cobs, whereas that on the tie-ridged formed cobs, but unfortunately they were all stolen before they could be harvested so the actual yield is not known.

A co-operative experiment with the Kenya Coffee Research Station on the effects of different cultivation treatments on the structure of a coffee soil has been brought to a close after three five-year pruning cycles. One of the objects of the

experiment was to measure the effect of weeding by various methods and the effect of mulch on the ability of the soil to soak up all the rain that falls in heavy storms. The conclusion reached is that soil cultivation using the hand fork, leaves the surface sufficiently cloddy for rain to sink in fairly quickly, but normal tractor drawn cultivation implements pulverize the surface soil too much. However a specially modified slow speed rotary cultivator was as effective as the hand fork in killing weeds and giving a cloddy tilth. It was also able to incorporate the remains of a mulch very satisfactorily at weeding time.

THE EFFECT OF SHADE AND SHADE TREES ON TEA

A co-operative experiment with the Tea Research Institute, Kericho and Messrs. Brooke Bond on the effect of shade on tea production at Limuru has been completed and is being written up for publication. In this experiment the unshaded tea gave definitely more leaf than the shaded during the peak seasons of the year.

Further work is being done on tea estates in Mufindi in Tanganyika in co-operation with the Tea Research Institute and Messrs. Tanganyika Tea Estates on the root systems of the tea bush and the shade tree to check the validity in Southern Tanganyika of the results we reported last year for tea and shade trees in Kenya. The results are not yet complete, but indications are that they are in accord with last year's findings.

AGRICULTURAL METEOROLOGY

Two lines of work are in progress. The first is extending our work on the measurement of the incoming solar radiation and the outgoing radiation from the crop or soil. The Munitalp Foundation is giving us invaluable assistance in this work by generously giving us much more suitable radiation equipment than we possess. The second line of work being developed is the measurement of the amount of water which is provided to crops through the mists and drizzles that are such a common feature of parts of East Africa during certain periods of the year. At the present time the work is confined to developing suitable instruments for making these measurements.

Chemistry Division

Dr. Birch has been investigating two separate but related problems during the year. The first was a continuation of last year's work on the changes which take place in the inorganic phosphates present in plant material during decomposition. This work has now been concluded and written up for publication.

He has also begun studying changes in the inorganic nitrogen compounds present during the decomposition of two contrasting grasses as a part of some co-operative work with the Pasture Chemist at the Kitale Grassland Research Station. The grasses were sampled at weekly intervals and their behaviour during decomposition was appreciably different. This was found to be due to the great differences in the amounts of ammonium and nitrate nitrogen present in the two grasses at corresponding periods of growth, and these differences are large enough to affect their value as cattle feeds, particularly at certain periods of the year.

Analytical Chemistry Division

This Division consists of a Spectrographic Section and a General Section.

The work of the Spectrographic Section fell into two parts, one of which is the gradual improvement in the techniques used for spectrographic analysis. The

improvements being investigated should allow work to be done more quickly or more accurately than with the methods in use, and this has allowed a considerable number of improvements in the techniques to be introduced during the year.

The second and, from the territorial point of view, more important side of the work is the analysis of soils and plants sent in or collected which are suspected of showing mineral deficiencies or excesses, or which come from fertilizer experiments. For example, this year suspected nutritional problems were investigated in forest plantations. In the Imatong Mountains of Uganda a stunted growth of some Callistris plantations appeared to be due to the very low potassium and probably also magnesium, coupled with a high calcium status in the soils. In another area the trouble appeared to be due to a high level of available chromium in the soil, and in an area near Loshoto, Tanganyika, pines were probably suffering from boron deficiency.

An examination of the plants in the northern Rift Valley in Tanganyika was also undertaken, and it revealed that the grasses growing in the Rift floor at the south end of the area were definitely too low in cobalt and copper for good cattle production. It also revealed areas of boron deficiency, sometimes coupled with magnesium deficiency as well.

In the General Section, soil samples have been analysed for a number of Departments, and co-operative work with the territorial chemists on the comparison of different methods of soil analysis has been undertaken. In addition, the Section co-operated with the Animal Husbandry Division in developing methods for determining ammonia and urea in cattle urine, and for preventing the hydrolosis of urea to ammonia in the urine from the time it was voided to when it was collected for analysis.

Vegetation and Soil Surveys

The work of the Ecological Division has been mainly concerned with the detailed vegetation survey of southern Kenya which was described in last year's Report. The primary scientific aim of the survey is to obtain a fuller understanding of the relation between vegetation, soil and climate on the one hand, and also between these and the potential agricultural use of the land on the other. The work is being carried out in collaboration with the Directorate of Overseas Surveys, London and the Kenya Department of Agriculture, and of the 41,000 sq. miles being surveyed some 34,000 were covered by the end of the year. In addition, the E.A. Meteorological Department are undertaking a full analysis of the available climatic data for the whole area, which involves locating precisely on the maps used the 650 recording stations of eight years' standing or over, and the collation of all the relevant data obtained from these stations in a suitable form. As soon as the vegetation survey is finished, a more detailed examination of the effects of climate on vegetation will be undertaken.

Mr. Trapnell also spent some time this year co-operating with the Directorate of Overseas Surveys to produce a description of the more important vegetation types present in East Africa, and a map showing where they occur, for the forthcoming Handbook of the Natural Resources of East Africa. This has given him the opportunity to develop a classification of vegetation types which is better adapted to East African conditions than those which had been proposed and accepted at a recent inter-African Specialist Meeting which was held at Yangambi in 1956.

Mr. Scott of the Soil Survey Division, has also spent part of the year in preparing a chapter on the soils of East Africa for the Natural Resources Handbook, and has taken this opportunity of preparing a new soils map of East Africa,

the last one being prepared by Mr. G. Milne over 20 years ago and long out of print. He has also been continuing the work that he started last year on the effects of rainfall and other climatic factors on the chemical composition of some of the more important East African soils. In addition, he has been preparing the soil reports for the experimental catchment areas being studied by the Physics Division, and carrying out some other soil surveys.

Plant Breeding

This work falls into two Divisions, one, the Sorghum Breeding Research Division is concerned with the general problems of improving sorghum yields through plant breeding methods, and the other, which is a part of the Pathology Division, is concerned with helping territorial plant breeders incorporate resistance against specific plant diseases into their crops.

Sorghum Breeding Research Division

This Division is situated on the Serere Agricultural Experiment Station belonging to the Uganda Department of Agriculture, and we are greatly indebted to the Director of Agriculture and to the members of his staff stationed there for the great help they give our staff in this work. The Division's programme of work is to study how far the yields of East African sorghums can be increased by incorporating into them characters which will confer resistance to a number of important pests and diseases on the one hand, and to test if autotetraploids can be produced which will give the same kind of increased yield that hybrid sorghums have given elsewhere, whilst at the same time breeding true to type. Work is concentrated on the food sorghums, hence palatability and ability to store well in the village are of prime importance, and bird and Striga resistance are being particularly studied on the pest resistance side.

This year, two lines of work have been developing well. In the first place, sorghums are being produced with gooseneck, large glume and long awn, all of which are expected to reduce bird damage, and the genetics of the inheritance of these characters is being worked out. Each is probably due to a number of non-dominant genes. The cause of Striga resistance in a number of sorghums is also being worked out, and it now looks clear that there are at least two different types of resistance, and an attempt is now being made to combine these into one line.

The other side of the work has been the comparison of the yield of a number of American hybrid sorghums with the best local sorghums, at a number of sites in East Africa. These experiments have been made in co-operation with the staff of the territorial Departments of Agriculture. The results of this work have been most interesting. The American hybrids have turned out to be very resistant to the principal fungus diseases which attack our sorghums, but which also occur in the U.S., but they are relatively susceptible to some of our insect pests which do not occur there. At those sites where the insects are of little importance and where there is little Striga, the U.S. hybrids bred for quite different conditions than those present in East Africa out-yielded our best local varieties, sometimes considerably. But where insect attack was severe, the local varieties out-yielded the American. This emphasizes the necessity to maintain general insect, fungus and Striga resistance in all our work. At Serere this year the second half of the year was very wet so that fungus diseases were widespread, and we were able to assess the relative resistance of a number of the sorghums growing there. It was very pleasing to note that some of our sorghums were as resistant as the American ones to the various fungal diseases present.

Streak Disease of Maize

Streak disease is a virus disease of maize which causes broken white lines running along the length of the leaf and, if the plant is infected early on in life, its growth may be stunted and its yield considerably reduced. All the East African maize varieties are susceptible to this disease, but some derivatives of the yellow maize originating in Peru are resistant or immune to it, and Dr. Storey is working on the problem of how to transfer this resistance from the Peruvian to our local East African white maizes.

The work on the mode of inheritance of streak resistance is still in progress, for the genetics of this resistance has proved very difficult to unravel. It is possible, however, that Dr. Storey has now succeeded in explaining the method of inheritance, at least in sufficient detail for practical and effective plant breeding methods to be developed for transferring this resistance to the local varieties. The correctness of his interpretation of this genetics will receive further testing in the coming year.

Central American Maize Rust

Work on this disease, which is due to the fungus *Puccinia polysora*, was an important part of Dr. Storey's programme from 1952 to 1957, and as a result of his work the territorial plant breeders were able to produce varieties of maizes which were resistant to the only race of this rust which was known to exist in East Africa, and seeds of these resistant maizes have been issued to African growers in Tanganyika and Kenya.

This work, which was then closed, is now being re-opened, because resistant varieties growing in the Shimba Hills district of Kenya have this year been severely attacked by the rust. Dr. Storey has now confirmed that this attack is due to a new race of the rust, and has begun a systematic search for maize varieties which are resistant to it. Unfortunately, so far, none of the varieties tested have shown any appreciable resistance, including a number from the Central American collection from which the original resistant varieties were found. This work is continuing.

Bean Rusts

As explained in last year's Report, white haricot beans suitable for canning could be a useful cash crop in a number of areas of East Africa, including in particular the Arusha area, but the yields of the varieties initially grown could be very severely reduced if attacked by the bean rust *Uromyces phaseoli* which attacks a very wide range of the beans (*Phaseolus vulgaris*) grown in East Africa as a normal African food crop. It was also agreed that E.A.A.F.R.O. should collaborate with a plant breeder of the Tanganyika Department of Agriculture at Tengeru to see if bean varieties suitable for the canning trade could be found or bred resistant to this rust.

The first problem which Dr. Storey, who is responsible for the E.A.A.F.R.O. side of this work, had to solve was to determine how many races of this rust existed in East Africa, for over 30 races have already been recognized elsewhere in the world, and a variety of bean resistant to one of these is often susceptible to attack by another. Rusted leaves of beans collected by the pathologists of all three territories are regularly being sent to E.A.A.F.R.O., and so far three races of the rust have been found, one more than last year, and all these three races are fairly widely distributed over East Africa. The typing of the races of these rusts is continuing.

The second problem is testing the range of haricot beans already collected at Tengeru for resistance to these three races. Fortunately several varieties of haricot which are suitable for the canning trade and which give a reasonable yield

when grown in the Arusha area, have been found resistant to all three races. Hence for the present there is no need to embark on a research programme for breeding beans resistant to this rust.

General Plant Pathology

Stem Pitting in Arabica Coffee

This is the name given to swelling and pitting which can occur low down on the stems of arabica coffee. A few years ago, when it was first recognized, it was suspected of being a serious disease in coffee, and it bore some similarity to a very serious virus disease of citrus known as Tristeza. Since no visible pathogen could be found which was likely to be the cause of the damage, Dr. Sheffield, the E.A.A.F.R.O. virologist, was asked to investigate if it could be caused by a virus such as the Tristeza virus. The conclusions which have been reached by this work are that this condition does not seem to cause much harm to the tree so long as it is confined to its base, that it is very unlikely to be due to a virus, and that although the various factors which cause it have not been fully identified, certain climatic factors probably favour its development. This work will soon be closed.

Nematode Diseases of Crops

These diseases are due to small worms or nematodes which commonly attack the roots of many agricultural and plantation crops, and can be very serious in nurseries. Most of the work of the nematologist has been confined to one group —the "root-knot" nematodes, which produce "knots", swellings or galls on the roots they attack—for they are almost certainly responsible for far more damage to crops in East Africa than any other group.

The work of this Division fell into three main sections this year. First of all, work is continuing on methods for distinguishing the different strains or species of these nematodes, for they all look much alike yet differ very considerably in the crops they attack. Considerable effort is being put into this side of the work, and good progress is being made. Secondly, detailed surveys of the frequency and severity of attack by each of the different species recognized are being made in twelve areas in different parts of East Africa, each one of which is situated in a region where there is intensive African agriculture. In eleven of these regions heavy attacks of "root-knot" are common on a wide range of subsistence crops grown. This survey is being carried out almost entirely by African assistants, always in close co-operation with the territorial Departments of Agriculture concerned. Thirdly, methods are being developed for reducing the damage these pests do either by a suitable choice of rotation crops, that is by alternating crops that are resistant to attack with crops that are susceptible, or by the use of chemical fumigants. Only the first method is likely to be of practical value for most crops in the field, though fumigation is an economic proposition in nurseries and for some high priced crops in the field. Particular attention is being paid to the problem of suitable rotations for tobacco in the Iringa area of Tanganyika, and as the result of experiments being conducted in the glasshouses here it is likely that a useful rotation can be suggested to the Department of Agriculture's experiment station at Seatondale for trial.

The Protection of East Africa from New Plant Diseases: the East African Plant Quarantine Station

One of the important tasks undertaken by the E.A.A.F.R.O. pathologists is to help the territories introduce new plants into East Africa without at the same time introducing new diseases. This raises a number of difficulties, for it is not

always possible to import plants that can be guaranteed entirely free from disease. It is of the greatest importance that the research workers in the territories in particular should be able to import new plants, or new varieties of plants, which are likely to be of value in raising the productivity of East African agriculture. To help them in this task the Governments have set up a Standing Committee on Plant Import and Export under Dr. Storey's chairmanship to advise them on the conditions under which such imports will be allowed. And in addition they have set up a Plant Quarantine Station at Muguga under Dr. Sheffield's technical direction into which many varieties of plants must enter before they can be released to the territorial workers.

Running a plant quarantine station effectively involves continuous research. Some plants passing through quarantine pose no problems, for it will be relatively easy to check if they are free from disease, in which case they can be released. But some plants carry diseases which cause no symptoms in them, and are apparently of no consequence to them, but which if transmitted to other plants can cause very serious symptoms and damage. Methods must therefore be worked out for testing if the plant is a symptomless carrier of certain specific diseases and if it can be proved to be free from these diseases it can then be released.

Finally, some plants are known to carry diseases which do not occur in East Africa, and under some conditions they can sometimes be accepted in plant quarantine and cuttings produced which are free from disease. These cuttings can then be released whilst the original plant itself with the disease it carried is destroyed.

There is in fact a continuous stream of plants going through the Plant Quarantine Station, and they are always posing new problems which the pathologists or horticulturist must solve before they can be released. This work occupies a considerable proportion of Dr. Sheffield's and Dr. Storey's time.

Animal Husbandry Division

The Animal Husbandry Division is primarily concerned with problems of the nutrition and management of indigenous cattle in the drier areas of East Africa. The experimental programme carried out in 1961 is a continuation of that described in last year's Report.

The Effect of Infrequent Watering of Cattle

A co-operative trial is in progress with the Department of Veterinary Services, Tanganyika, on the effect of infrequent watering and long treks to water on the rate of growth of indigenous cattle. The results analysed to date suggest that long daily treks and watering at three-day intervals do not of themselves have a very serious effect on the growth rate, provided the animal is adequately supplied with fodder, and this fodder can be the normal dry herbage with low nitrogen content which is typical of well managed rangeland under these dry conditions. This severity of deprivation of water has not resulted in any serious changes in the blood composition, which suggests that it is not severe enough to affect the normal functioning of the animal.

Growth Rates of Indigenous Cattle

This is an experiment in which we are comparing growth rates of the large Boran type of animal from the Northern District of Kenya with the smaller Shorthorn Zebu, and it is being conducted under two conditions of feeding: a low plane of feeding, which is obtained by running them on the Kedong Ranch, and a high plane of feeding, which is obtained by bringing them up to Muguga, keeping them on our best pastures, and giving them additional hay and concentrates. The Kedong Ranch is typical Themeda-Acacia bush country and for most of the year it was suffering from a severe drought so the nutritive value of the herbage would be judged very low.

About half the number of groups of calves needed for these comparisons have now been assembled, and the results to date are extremely interesting, for there has been so far remarkably little difference between the growth rate of the calves from the different groups of cows, nor has there been any appreciable difference between those living on our Kedong Ranch and those brought up to Muguga where they have much better grazing conditions and are fed supplementary hay and concentrates. On the other hand, the cows have not been milked, so all their milk has been available for the calf. These preliminary results suggest that the principal reason for the differences in size between the various groups of Shorthorn Zebu from the different areas of East Africa is due more to management, and probably the level of feeding during the early life of the animals than to breeding.

The Nitrogen Requirements of Indigenous Cattle

There is much practical evidence that Zebu cattle can thrive on poorer pastures than can exotics, though so far no satisfactory explanation of why this should be has been given. Experimental work was planned last year to test if the reason for this is that Zebu cattle do not excrete as much nitrogen in their urine, either as urea or other compounds, as do exotics, when fed on low protein forages. The work has taken longer to get going than was expected for a number of technical reasons, but these difficulties have been largely overcome, and the preliminary experimental results are so far in accord with our predictions.

Carcass Analysis of Indigenous Cattle

The original programme of work of our Meat Research Unit was on the routine carcass analysis of unselected Boran steers, of varying ages and weights, reared on grass. The corresponding information for exotic beef stock reared in temperate countries has been available for a number of years but there was no corresponding information available for Zebu animals. The principal differences between the way these two groups of cattle put on bone, muscle and fat during their growth is now being worked out and the first section of this work is now drawing to a close.

The Unit has been co-operating with the Tanganyika Veterinary Department on the possibility of assessing the proportion of bone, muscle and fat on a carcass from the analysis of a small sample joint, and it has been shown that the 10th rib joint is suitable for this purpose. This work is now being extended to finding a comparable joint for assessing the composition of the carcass of the fat tailed sheep.

A few carcass analyses have been made during the year of some species of ruminant game animals. This work is already suggesting some important relationships between the ability of animals to use low quality fodders and to withstand water deprivation with the composition of its carcass and its digestive system.

Muguga Identical Twin Herd

A careful lookout is continuing to be kept for identical twins to be added to this herd, and the farming community have continued to co-operate with us in letting us know whenever they believe they have a suitable set. At the present time the herd consists of 28 sets of Grade, nine sets of part-Zebu, and 22 sets of Zebu twins. It is being invaluable for our experimental programmes and sets are continually being withdrawn from it for experimental purposes both at Muguga and elsewhere.

The Silviculture Division

The lines of work of this Division were agreed in broad outline with the territorial Forestry Departments in 1952, and the programme was intended to cover a period of ten years. This programme is therefore drawing to a close and

it is hoped that all the findings will be presented to the 8th British Commonwealth Forestry Conference which is being held in East Africa in June and July, 1962. In addition the Division has continued to run the Forestry Bureau which provides an information service to the territorial Departments, and it has held forestry courses for Assistant Conservators, Foresters, and Forest Rangers at which we endeavour through discussion, instruction and demonstrations to help the territorial staff translate our research findings into practice.

The Division has also completed the compilation of the first provisional yield table for cypresses of the *C. lusitanica* group on an East African basis. This will be issued early in 1962.

The Early Growth of Pine Seedlings after Transplanting

One of the principal problems we have been concerned with is developing methods of raising seedlings in the nursery, and of transplanting them in the field, to ensure that they will have the maximum chance of survival even if the long rains are light. This year the long rains were again very light at Muguga and there had been a long drought before they came, but again, all the plants raised and planted out according to the methods we have developed survived these conditions very satisfactorily.

The principal new research work we have been undertaking is studying the root development in a number of species and mycorrhiza development on young pines just after transplanting. Last year's results have been confirmed and, in particular, this year's results have shown that different species take different times to start sending out new roots after transplanting. In addition young pines planted early in the season took a longer time to start making new root growth than those planted later, but they had a more robust root system by the end of the rains. We also found that pine seedlings hardened off by our normal nursery techniques developed new roots after transplanting at the same rate as those which received much less hardening off.

The International Eucalypt Trial

We have been carrying out a comparative eucalypt trial since 1957 in co-operation with the International Union of Forest Research Organizations. In this trial twelve species of Australian eucalypt are being compared, of which only four strains representing two species have shown promise. An interesting and important finding has been the marked variability between the behaviour of eucalypts of the same species but whose seed had a different origin, particularly in their ability to withstand drought.

The Effect of Pruning on Tree Growth

Two experiments were started in 1958 to test the effect of varying intensive prunings on the rate of growth of a cypress (*Cupressus lusitanica*) and a pine (*Pinus radiata*) on their height growth and on their girth. It will be many years before these experiments are completed, but already the pruning treatments have resulted in a reduction of between 10 and 50 per cent on the increase in the volume of the trunk, depending on the intensity of pruning.

Forest Entomology Division

Protecting Our Forests from Insect Attacks

The Forest Entomology Division has three principal functions. Firstly it is responsible for maintaining the central reference collection of forest insects and co-operating with the territorial forest departments and their forest entomologists in arranging for regular collections of the insects living in the forest, particularly those likely to be pests on the trees, or be parasites of the pests, or have other

appreciable effects on the trees or their natural regeneration. Work on this collection is always in progress, but one of the greatest difficulties our entomologists face is that so many of the insects caught are new species which have never previously been described or named, and the naming of new species is a highly specialized business which lies outside our programmes of work.

The second important problem concerns insects, usually beetles, which lay their eggs on the outside of the tree, and their larvae bore into the living tree, and make large tunnels, which may be several inches in diameter and several feet long, in the wood. These tunnels either reduce the value of the timber in the tree very considerably or may render the tree useless as timber. The trees which have been principally studied in the last two years are several species of indigenous trees in the natural forests of Tanganyika and Uganda. The beetles responsible for the damage done have now been discovered, and something is also known about their life histories. As a consequence, for some of the beetles, methods of inspection of the standing trees have now been developed by which a forester can estimate the severity of recent attacks.

The third important line of work concerns the protection of young plantations against termite attacks, for in many areas of East Africa species of trees which would be invaluable as forest can be so badly attacked when young that almost all the young trees are killed. Methods are now being developed, based on the use of an insecticide, which appear to give the young trees protection for a number of months. Unfortunately the results of these experiments have not been as clear cut as we had hoped owing to the very severe droughts, with the consequence that many trees have died of drought and the plantings have in fact failed for reasons other than attacks by termites.

The East African Herbarium

E.A.A.F.R.O. maintains some service Divisions whose principal function is to help territorial research officers rather than carry out research themselves, although they are given some opportunities for carrying out research. The East African Herbarium is such a Division. Its primary function is to maintain as complete a collection as possible of specimens of all the various plants growing in East Africa and in neighbouring countries, all of which must be correctly named and these names be kept up to date whenever they are changed by international agreement. An important function of the staff is therefore to help expand the collection by obtaining specimens of plants not already in the collection, which they do in a number of ways, one of which is either to organize expeditions themselves, or else to help other bodies organize them for collecting plants in those parts of East Africa where the vegetation is not well known. Secondly, and this takes up a great deal of their time, they name collections of plants sent in by territorial research officers, often ecologists, pasture specialists or silviculturists, or by collecting expeditions. Thirdly, either by themselves, or in co-operation with other botanists, they produce monographs on groups of plants which may be the grasses or the trees and shrubs of an area, or it may be on a family of plants, to help other botanists classify or name their plants.

During the year the Herbarium staff have been busy on all these lines of work. Amongst the publications issued during the year has been a monograph on The Grasses of Uganda by Miss Napper of the Herbarium and Dr. Harker of the Uganda Department of Veterinary Services, and one on Kenya Trees and Shrubs, by Mr. Dale, who was a member of the Kenya Forestry Department, and Dr. Greenway, who was Head of the Herbarium until he retired recently. In addition, the staff have prepared monographs on several families of plants which have been sent to the Kew Herbarium in London for inclusion in the Flora of Tropical East Africa, for whose publication Kew is responsible.

RESEARCH STAFF OF THE EAST AFRICAN AGRICULTURE AND FORESTRY RESEARCH ORGANIZATION AT 31st DECEMBER, 1961

(*Indicates new arrivals during the year)

DIRECTORATE

E. W. Russell, C.M.G., M.A., Ph.D., F.Inst.P., Director.
W. J. A. Payne, M.A., Ph.D., Dip.Agric.Sc., Deputy Director.

RESEARCH DIVISION

Animal Husbandry

(W. J. A. Payne, M.A., Ph.D., Dip.Agric.Sc.), Officer-in-Charge.
H. G. Livingston, B.Sc., Ph.D., Dip. Dairy Husbandry, Animal Husbandry Officer.
H. P. Ledger, N.D.D., Animal Husbandry Officer.
A. F. Dent, Dip.Agric., Dip. Dairying, Farm Manager.
*M. Njoroge, M.Sc., Scientific Assistant.
*I. Patchett, Agricultural Assistant.

Chemistry

H. F. Birch, B.Sc., Ph.D., Chemist-in-Charge.
Mrs. C. C. Hood, B.Sc., Scientific Assistant.

General Analytical Chemistry

G. T. Chamberlain, Spectrochemist.
M. T. Friend, M.Sc., A.R.I.C., Analytical Chemist.
A. J. Searle, Scientific Assistant.
*P. K. Patel, B.Sc., Scientific Assistant.

Ecology

C. G. Trapnell, O.B.E., B.A., Ecologist.

Forestry

A. L. Griffith, O.B.E., M.A., D.Sc., Silviculturist-in-Charge.
P. Howland, Forester.

Forest Entomology

W. Wilkinson, B.Sc., M.I.Biol., Forest Entomologist.
T. Jones, B.Sc., A.R.C.S., Forest Entomologist.

Horticulture

W. B. May, F.R.H.S., Horticulturist.

Nematology

A. G. Whitehead, B.Sc., A.R.C.S., Nematologist.
Mrs. M. A. Ledger, N.D.D., Scientific Assistant.

Plant Breeding

H. Doggett, M.A., A.I.C.T.A., Plant Breeder-in-Charge.
D. Jowett, B.Sc., Ph.D., Plant Breeder.

Plant Pathology

H. H. Storey, C.M.G., M.A., Ph.D., F.R.S., Plant Pathologist.
Miss F. M. L. Sheffield, D.Sc., Plant Pathologist.
Mrs. A. K. Howland, B.Sc., Scientific Assistant.
*H. Y. Kulkarni, M.Sc., Scientific Assistant.

Plant Physiology

J. Glover, M.Sc., Plant Physiologist.

Physics

J. S. G. McCulloch, B.Sc., Ph.D., Physicist-in-Charge.
O. Kerfoot, M.A., B.Sc., Silviculturist.
M. Dagg, B.Sc., Ph.D., Soil Physicist.
P. H. Hosegood, Scientific Assistant.
J. A. Forsgate, Scientific Assistant.

Soil Survey

R. M. Scott, B.Sc., Soil Surveyor.

Systematic Botany

B. Verdcourt, B.Sc., Ph.D., Botanist-in-Charge of the East African Herbarium.
G. L. Lucas, B.Sc., F.L.S., Botanist.
Miss D. M. Napper, B.Sc., Scientific Assistant.

DEPARTURES FROM RESEARCH DIVISION SINCE 31ST DECEMBER, 1960

H. C. Pereira, D.Sc., Deputy Director, resigned.
K. R. Southon, Dip.Agric.(Egerton), Agricultural Assistant, resigned.
Mrs. A. E. Bazin, Scientific Assistant, resigned.
C. A. Spinage, Scientific Assistant, resigned.
M. A. C. Pratt, Scientific Assistant, resigned.
R. M. Pouhill, B.A., Scientific Assistant, resigned.

MISCELLANEOUS SCIENTIFIC SERVICES

Joint E.A.A.F.R.O./E.A.V.R.O. Library

Mrs. L. Verdcourt, A.L.A., Librarian.
*Miss J. P. H. Storey, Assistant to Librarian.

The East African Agricultural and Forestry Journal

(H. F. Birch, B.Sc., Ph.D.), Editor.
*Mrs. M. Drummond, Assistant to Editor.

Plant Quarantine Station

(Miss F. M. L. Sheffield, D.Sc.), Pathologist-in-Charge.
P. J. Dickinson, Dip.Hort., Scientific Assistant.

ADMINISTRATION

LT.-COL. G. G. Robson, P.S.C., Secretary.
*G. H. Simpson, F.A.C.S., Accountant.
J. B. Drummond, M.I.C.W.A., Senior Maintenance Superintendent.
L. Boundford, Maintenance Superintendent.
L. R. F. D'Souza, Storekeeper.

LIST OF PUBLISHED PAPERS BY E.A.A.F.R.O. STAFF DURING THE YEAR 1961

BIRCH, H. F. (1961). Phosphorus transformation during plant decomposition. *Plant and Soil, 15.*

BIRCH, H. F. and M. T. FRIEND (1961). Resistance of humus to decomposition. *Nature, Lond., 191,* 731-732.

CHAMBERLAIN, G. T. (1961). Variable internal standard calibration. *Spectrochim. Acta., 17,* 575-578.

DE GRISSE, A. (1960). *Meloidogyne kikuyensis* n.sp., a parasite of Kikuyu grass. (*Pennisetum clandestinum*) in Kenya. *Nematologica, 5,* 303-308.

GIBSON, IAN A. S., LEDGER, M. and E. BOEHM (1961). An anomalous effect of Pentachloronitrobenzene on the incidence of damping-off caused by a Pythium sp. *Phytopathology, 51,* 531-533.

GLOVER, J. (1961). Comparative efficiency of digestion of feeds by ruminants and pigs. *J. agric. Sci., 56,* 113-115.

GLOVER, J. and H. W. DOUGALL (1961). Estimation of the average total digestible nutrients in pig feeds. *J. agric. Sci., 56,* 117.

GLOVER, J. and H. W. DOUGALL (1961). Milk production from pasture. *J. agric. Sci., 56,* 261-264.

GLOVER, J. and H. W. DOUGALL (1961). A table of estimates of nutritive values of pig feeds. *E. Afr. agric. for. J., 26,* 219.

GLOVER, J., MCCULLOCH, J. S. G. and H. W. DOUGALL (1961). Protein digestibility in the ruminant. *Rhod. agric. J., 58,* 136-139.

GLOVER, P. E. and M. D. GWYNNE (1961). The destruction of Masailand. *New Sci., 11,* 450-453.

GRIFFITH, A. L. (1961). Dry woodlands in Africa South of the Sahara. *Unasylva, 15,* 1-12.

GRIFFITHS, E. and H. F. BIRCH (1961). Microbiological changes in freshly moistened soil. *Nature, Lond., 189,* 424.

GWYNNE, M. D. and J. GLOVER (1961). Light rainfall and plant survival. Measurement of stem flow run-off. *Nature, Lond., 191,* 1321-1322.

HOWLAND, P. and A. L. GRIFFITH (1961). The root development of transplants after planting in the field. *Emp. For. Rev., 40,* 67-70.

JONES, TECWYN (1961). A note on *Analeptes trifasciata* Fabr. and *Paranaleptes reticulata* Thoms. (Coleop. Lamiinae) two tree girdling beetles of tropical Africa. *E. Afr. agric. for. J., 27,* 36-39.

KERFOOT, O. (1961). C.C.T.A./C.S.A. Inter-African Conference on Hydrology, Nairobi, 16th-26th January, 1961. *Emp. For. Rev., 40,* 139-141.

KERFOOT, O. (1961). *Juniperus procera* Endl. (The African pencil cedar) in Africa and Arabia. *E. Afr. agric. for. J., 26,* 170-177.

KERFOOT, O. (1961). Tea root systems. *Tea Res. Inst. E. Afr. Pamphlet No. 19,* June, 66-71.

KERFOOT, O. (1961). The vegetation of the S.W. Mau forest nature reserve. *Wild Life, 3,* (2) 53-56.

MAY, W. B. (1961). A technique for grafting conifers in the field in East Africa. *E. Afr. agric. for. J., 27,* 20-21.

PAYNE, W. J. A. (1961). Notes on the utility of Kenya feeding stuffs considered suitable for pigs. *E. Afr. agric. for. J., 26,* 224-227.

PEREIRA, H. C., HOSEGOOD, P. H. and D. B. THOMAS (1961). The productivity of tropical semi-arid thorn-scrub country under intensive management, *Emp. J. exp. agric., 29,* 269-286.

QUARTERMAN, J. (1961). The digestibility of crude fibre in the tropics. *Emp. J. exp. agric., 29,* 101-109.

SHEFFIELD, F. M. L. (1961). Interim report on studies of the stem-pitting condition in coffee. *Kenya Coffee, XXVI,* 376-377.

STOREY, H. H. (1961). Vector relationships of plant viruses. *E.A. Med. J., 38,* 215-220.

STOREY, H. H. and G. M. THOMSON (1961). Streak disease from "Sugar Cane Diseases of the World". Vol. 1: International Society of the Sugar Cane Technologists.

TALBOT, LEE M. and J. S. G. MCCULLOCH (1961). A method for determining weight of wild animals from external body measurements. Conference on Land Management problems in areas containing Game, Lake Manyara, Tanganyika. 20th-22nd February, 1961.

VERDCOURT, B. (1960). Notes from the East African Herbarium, Part X, *Kew Bull., 14,* 335-342.

VERDCOURT, B. (1960). Note from the East African Herbarium. Part XI, *Kew Bull., 14,* 345-352.

VERDCOURT, B. (1961). Achatina fulica hamillei (Petit) in the Kavirondo district of Kenya. *J. Conch., 25,* 34.

VERDCOURT, B. (1961). Boysia boysii (Pfeiffer) (Pupillidae) in Africa. *J. Conch., 25,* 35.

VERDCOURT, B. (1961). The cowries of the East African coasts. Suppl. 3. *J. E. Afr. Nat. Hist. Soc., 23,* 281-285.

VERDCOURT, B. (1961). The genus *Monochoria* (Pontederiaceae) in Africa. *Kirkia, 1,* 80-83.

VERDCOURT, B. (1961). New Convolvulaceae from Flora Zambesiaca area. *Kirkia, 1,* 26-31.

VERDCOURT, B. (1961). A new species of *Helicarionidae* from Portuguese East Africa together with a discussion of the affinities of several other East African species. *J. Conchyliol, CI,* 120-134.

VERDCOURT, B. (1961). Notes from the East African Herbarium, Part XII, *Kew Bull., 15,* 1-18.

VERDCOURT, B. (1961). Notes on East African Enidae. *J. Conch., 25,* 9-14.

VERDCOURT, B. (1961). Notes on Kenya land and freshwater snails. Part VII. Variation in Gulella pilula (Preston) (Streptaxidae). *Basteria, 25,* 37-40.

VERDCOURT, B. (1961). Notes on the snails of North-East Tanganyika. Part IX. A new species of *Gonaxis* (Streptaxidae) from the Usambara Mountains with notes on the classification of the genus. *Coryndon Mem. Mus. Occ. Paper, No. 8,* July, 1961.

VERDCOURT, B. and R. POLHILL (1961). East African slugs of the family Urocyclidae. Parts III and IV. The Genus Trichoxon. *J. E. Afr. Nat. Hist. Soc.,* Special Suppl. No. 7, April, 1961, 36.

RECENTLY PUBLISHED BOOKS BY PRESENT AND PAST MEMBERS OF E.A.A.F.R.O. STAFF

WILLIAMSON, G. and W. J. A. PAYNE (1960). An introduction to animal husbandry in the tropics. Longmans, Green and Co., London.

DALE, IVAN R. and P. J. GREENWAY (1961). Kenya trees and shrubs. Buchanan's Kenya Estates Ltd.

HARKER, K. W. and D. NAPPER (1961). An illustrated guide to the grasses of Uganda, Govt. Printer, Uganda.

RUSSELL, E. W. (1961). Soil Conditions and Plant Growth, 9th Edition, Longmans, Green and Co., London.

LIST OF PAPERS GIVEN TO CONFERENCES BY E.A.A.F.R.O. STAFF

DAGG, M. and M. A. C. PRATT (1961). Storm flow from a forested catchment. *Proc. Inter-Afr. Hydrol. Conf.*, January, 1961.

LEDGER, H. P. (1961). The importance of stock selection for increasing the productivity of semi-arid areas. *Proc. C.C.T.A./I.U.C.N. Game Conference*, Arusha, Tanganyika, September, 1961.

LEDGER, H. P., PAYNE, W. J. A. and LEE M. TALBOT (1961). A preliminary investigation of the relationship between body composition and productive efficiency of meat producing animals in the dry tropics. *8th Int. Congr. Anim. Husb.*, Hamburg.

LEDGER, H. P., PAYNE, W. J. A. and LEE M. TALBOT (1961). The use of carcass techniques for investigating the meat production potential of game and domesticated animals in semi-arid areas. Conference of land management problems in areas containing game. Lake Manyara, Tanganyika, 20th-22nd February, 1961.

LIVINGSTON, H. G. (1961). A guide to pasture evaluation techniques for research workers in East Africa. *Pasture Research Specialist Committee*, Entebbe, Uganda.

LIVINGSTON, H. G. (1961). Metabolic stress and nitrogen excretion. Paper No. 7, Conference on land management problems in areas containing game, Lake Manyara, Tanganyika, 20th-22nd February, 1961.

MCCULLOCH, J. S. G. (1961). Evaporation pans in East and Central Africa. *Proc. Inter-Afr. Hydrol. Conf.*, January, 1961.

MCCULLOCH, J. S. G. (1961). The Penman equation for estimation of open water evaporation and transpiration. *Proc. Inter-Afr. Hydrol. Conf.*, January, 1961.

MCCULLOCH, J. S. G. (1961). Statistical assessment of damaged timber. Cyclostyled memo.

MCCULLOCH, J. S. G. (1961). Statistical assessment of rainfall. *Proc. Inter-Afr. Hydrol. Conf.*, January, 1961.

MCCULLOCH, J. S. G. (1961). Soil moisture build-up at planting time. Cyclostyled.

MCCULLOCH, J. S. G. and M. D. GWYNNE (1961). Some remarks on pineapple irrigation. Cyclostyled memo.

PAYNE, W. J. A. (1961). Research and improvement of animal production in East Africa. Paper No. 4, Technical Conference of Directors and Senior Officers of Overseas Departments of Agriculture and Agricultural Institutions, Wye, U.K., September, 1961.

PAYNE, W. J. A. *et al.* (1961). A provisional report on a study of the water requirements and productivity of Zebu cattle when subject to the stress of infrequent watering and long daily treks. *8th Int. Congr. Anim. Husb.*, Hamburg.

PEREIRA, H. C. (1961). Land use hydrology in Africa. *Proc. Inter-Afr. Hydrol. Conf.*, January, 1961.

PEREIRA, H. C., DAGG, M. and P. H. HOSEGOOD (1961). An intensive method of catchment-basin study. *Proc. Inter-Afr. Hydrol. Conf.*, January, 1961.

RUSSELL, E. W. (1961). The use and limitations of soil and vegetation surveys in agricultural development projects. Technical Conference of Directors and Senior Officers of Overseas Departments of Agriculture and Agricultural Institutions, Wye, U.K., September, 1961.

WHITEHEAD, A. G. (1961). Plant Nematology Progress Report to the Specialist Committee on Agricultural Botany.

WHITEHEAD, A. G. (1961). Proceedings of the 1st Inter-African Plant Nematology Conference held in the Conference Room, East African Agriculture and Forestry Research Organization, Kikuku, Kenya, October 24th-28th, 1960.

EAST AFRICAN VETERINARY RESEARCH ORGANIZATION

DIRECTOR—MR. H. R. BINNS, C.M.G., O.B.E., M.A., B.Sc., M.R.C.V.S.

The year 1961 again saw considerable difficulties in the staffing of the scientific activities of the Organization and recruitment was virtually at a standstill. Nevertheless, good progress was made in a number of lines of research which are outlined in this Report.

The Staff of E.A.V.R.O.

The effects on the staffing of the research organizations of the constitutional changes occurring throughout Africa, and of the world-wide competition in the recruitment of scientists, were stressed last year. During 1961 these problems were accentuated by the change in status of the East Africa High Commission which resulted in the creation of the East African Common Services Organization, and also by the uncertainties associated with the examination of the research services by the Frazer Commission, whose report was published at the end of the year. The change in the normal system of recruitment, from permanent employment to contracts of relatively short duration, will also affect long-term research on tropical problems.

Mr. R. N. Gourlay, B.Sc., M.R.C.V.S., Dip.Bact., who was seconded from Uganda to E.A.V.R.O. last year, was transferred outright in September, 1961, to the post of Veterinary Research Officer (Bacteriologist) and is continuing his valuable researches on contagious bovine pleuropneumonia. Dr. B. Liess, animal virologist from Hanover University, joined E.A.V.R.O. as a visiting scientist in October and will work for two years in the organization, mainly on rinderpest: he is being financed by the Deutsche Forschungsgemeinschaft.

Only a small number of Research Officers were on leave during the year and consequently there were fewer attendances at scientific conferences and meetings than in 1960.

The Director, Mr. H. R. Binns, attended the meetings of the Inter-African Advisory Committee for Animal Health and the Council of Management of the Inter-African Bureau for Animal Health, both held in July at Victoria Falls. The former meeting expressed appreciation of the new laboratory techniques evolved by E.A.V.R.O., and their application to the study of infections in wild animals, and recommended that the Foundation for Mutual Assistance in Africa (F.A.M.A.) be requested to obtain funds for the employment at Muguga of an additional virologist to work for two years on diseases of wild life.

The Specialist Committee on Animal Disease Research met at Muguga on 23rd October, and was attended by 19 territorial and interterritorial research and specialist officers. The Specialist Committee on Animal Nutrition, Physiology and Breeding met at Muguga on the 25th and 26th October, and was attended by 22 research and specialist officers and visiting scientists. The Director of E.A.V.R.O. is Chairman and convenor of both these Committees.

The Scientific Work of E.A.V.R.O.

The Division of Virus Diseases again concentrated mainly on research on rinderpest and further results of much practical value were achieved. The most important of these were the successful application to several rinderpest problems of the method of primary isolation of the virus in tissue culture, developed in 1960 by Mr. W. Plowright and Mr. R. D. Ferris, and good progress in laboratory and field experiments on the new tissue culture rinderpest vaccine evolved by Mr. Plowright and Mr. Ferris.

The large-scale field trials of the new vaccine have continued and expanded; grade, Zebu and Ankole cattle being inoculated. The serological response to vaccination, and the duration of immunity conferred are being studied in selected herds of these cattle. A small experimental group of cattle at the laboratory was immune four years after vaccination. The results of these field trials are being accumulated and the vaccine will soon be used extensively in East Africa, probably in the first instance in the types of cattle now immunized with lapinized rinderpest virus vaccine. The E.A.V.R.O. strain of tissue culture virus is already being used for the production of vaccine by the veterinary laboratories at Vom in Nigeria and at Fort Lamy in the Tchad. The strain has also been sent to the laboratory at Onderstepoort in South Africa, in case it should be needed for the emergency production of large quantities of vaccine in the event of a serious southward spread of rinderpest.

Further research by Mr. Plowright on his method for the isolation and titration of rinderpest virus in tissue culture has shown that specific identification can be made by the use of rinderpest-immune serum in the maintenance medium for the cultures. This suppresses completely the characteristic cytopathic changes, which usually appear in unprotected cultures four to seven days after inoculation. A rapid specific diagnosis can thus be made by primary inoculation into culture, and without the use of cattle. During 1961 strains of rinderpest virus were isolated by this method from seven natural outbreaks of the disease in cattle in northern Tanganyika and Kenya Masailand, and one from a case of buffalo. All eight strains have been studied in cattle at the laboratory, producing a mild, non-lethal form of rinderpest which could easily be overlooked in the field.

This virus isolation technique, and serum neutralization tests in tissue culture, have been used to investigate the incidence of rinderpest in wildebeest of all ages, and interesting new light has been thrown on their role in the propagation of the disease in enzootic areas. Mr. Plowright is extending these important studies to other species of antelope, which will further increase our understanding of the epizootiology of rinderpest in wild animals and their role in the transmission of the disease to cattle.

Research has been done by E.A.V.R.O. and the Department of Pathology in the University of Cambridge on the size, shape and structure of rinderpest virus, which were hitherto unknown. Mr. Plowright has produced and inactivated tissue culture virus which was then studied by electron microscopy by Dr. A. P. Waterson and Dr. J. G. Cruikshank of Cambridge. This collaborative basic research is being extended to other East African animal viruses grown in tissue culture in E.A.V.R.O.

Dr. G. R. Scott went on leave in July. Before doing so he carried out various investigations on rinderpest. His long-term studies on the duration of immunity following the attenuated vaccines were continued and will be completed in 1962. An improved method of producing K.A.G. (caprinized) vaccine was developed with the assistance of Mr. L. W. Rowe. Laboratory studies were made on rinderpest in Masai and Merino sheep, throwing light on their susceptibility and role in epizootiology.

The Division produces all rinderpest vaccine used in East Africa and several other territories. During the year 2,838,840 doses of K.A.G. (caprinized) virus vaccine and 707,036 doses of lapinized virus vaccine were issued. The spread of rinderpest in the Congo feared early in the year fortunately did not occur, but large reserves of the two vaccines were rapidly built up by Mr. C. S. Rampton and his assistants, and are available at Muguga in case of an emergency or a serious threat to East Africa. Only 48,000 doses of lapinized vaccine were sent to the Congo. Some of this was used in a fulminating outbreak in ranches in the

Equateur Province, where about 4,500 cattle died in one month before the disease was quickly controlled with E.A.V.R.O. vaccine. This outbreak was an indication of what may happen when rinderpest affects a highly susceptible cattle population in an area previously free of the disease, and of the vital need for maintaining effective immunization in Africa.

Good progress was again made in various lines of research on African swine fever by the United States Department of Agriculture team of virologists working in E.A.V.R.O. Dr. W. R. Hess continued his research on A.S.F. virus in tissue culture, using several strains including three from Portugal and Spain, and on the immunogenic relationship between different strains of the virus. He has also investigated the resistance of A.S.F. virus, and the effects of temperature and a wide range of pH. The simplified haemadsorption inhibition test developed in 1960 is now used as a standard procedure in research and diagnosis. Dr. K. M. Cowan made valuable advances in his work on the immunology of A.S.F. before returning to the U.S.A. in September, after about three years of excellent and fruitful research in E.A.V.R.O. His complement fixation test was developed further during the year, and he successfully evolved an agar gel precipitin reaction and used it in extensive studies of A.S.F. antigens. Dr. B. F. Cox continued the studies on the epizootiology of the disease which had been soundly established by Dr. DeTray, concentrating mainly on the role of bushpig as carriers of the virus.

The valuable results achieved during the past five years in research on A.S.F. by the American team of virologists working in E.A.V.R.O., have assumed wide international significance due to the serious epizootic of the disease in Portugal and Spain, and the threat of further spread in Europe. A training course on the laboratory diagnostic methods for A.S.F. developed here at Muguga was organized by F.A.O. and the Office Internationale des Epizooties in Madrid in April. The plans for this course were made here and instruction was given in Madrid by Dr. Hess. It was attended by scientists from most countries in western Europe, who were very appreciative of this opportunity of learning to diagnose the disease.

Mr. Plowright continued his research on bovine malignant catarrh, especially the epizootiology and studies on the disease in cattle and the virus in tissue culture. Much interesting new information on the role of wildebeest in the epizootiology was obtained in collaboration with the Warden of the Nairobi National Park, and the Veterinary Investigation Officer and the Ngorongoro Conservation Authority at Arusha. About 25 young wildebeest calves, abandoned by their dams due to the drought, were brought to Muguga, thus providing a unique opportunity for elucidation of the viraemia in carrier wildebeest and of transmission to cattle. The method of isolation of B.M.C. virus in tissue culture evolved by Mr. Plowright and Mr. Ferris has proved most effective in these studies.

The Division of Bacterial Diseases has concentrated entirely on contagious bovine pleuropneumonia. Mr. R. N. Gourlay continued his research on the immunology of the disease and on the antigens of *M. mycoides,* the causal organism of C.B.P.P., so as to elucidate their role in immunity and in the immune mechanisms of the disease. He has been ably assisted by Mr. R. F. Palmer. The aim of this work is to try to isolate and identify the immunogenic antigen or antigens, by use of chemical, serological and biological methods. Mr. Gourlay was on leave from May to September and visited several institutions working on the fractionation and purification of bacterial antigens, thus acquiring valuable experience and techniques applicable to his research on *M. mycoides.* Mr. Gourlay and Mr. Palmer are also undertaking a series of experiments on the freeze-drying of *M. mycoides,* using various suspending agents, with a view to developing an effective method of overcoming the poor keeping qualities of liquid culture vaccine for C.B.P.P.

Dr. R. D. Brown has investigated two methods of immunization against C.B.P.P. which have given good results elsewhere. These are the technique of muzzle inoculation of cattle with avianized vaccine which was developed in the Tchad, and the use as a vaccine of the mild KH3/J strain of *M. mycoides* which was shown to immunize effectively in Nigeria. Results obtained hitherto at Muguga indicate that further work is necessary before the efficacy of these two methods can be adequately assessed in East Africa. Dr. Brown has also established at Muguga the method of producing C.B.P.P. by endobronchial inoculation evolved in Australia, with the object of developing in E.A.V.R.O. a standard method of challenge in determining immunity and testing vaccines, to replace subcutaneous injection which is unsatisfactory. Some difficulty has been experienced with the method due to inability to obtain local strains of *M. mycoides* of sufficient virulence, but a strain from Somalia acquired at the end of the year seems promising.

F.A.M.A. made arrangements towards the end of 1961 for the establishment in Kenya of F.A.M.A. Joint Project 16 for research on C.B.P.P., the laboratory aspects of the scheme to be carried out in E.A.V.R.O. and the field studies to be based at the Kenya Veterinary Research Laboratory at Kabete. This important project, which is designed to produce results applicable wherever pleuropneumonia exists in Africa or elsewhere, provides for three additional scientists and two technicians to do research at Muguga for a total of 3½ years, and for one scientist at Kabete to study epizootiology and do other field investigations for three years. The scheme will cost about £120,000, all of which is being obtained by F.A.M.A. from international sources.

This major F.A.M.A. project is comparable in scope to the co-operative research on virus diseases by E.A.V.R.O. and the U.S. Department of Agriculture, which has provided such fruitful results during the past five years, especially in research on African swine fever. Both schemes could usefully serve as patterns for the future financing of regional research in Africa with funds from external sources.

The Division of Protozoal Diseases has continued long-term research on East Coast fever and allied theileriasis, and on East African ticks, especially the vectors of animal disease. Mr. D. W. Brocklesby and Miss B. O. Vidler made further progress in their studies on various strains of *Theileria parva,* on the carrier state in cattle recovered from Theilerial infections, and on the relationship between *T. parva* and *T. lawrencei,* the parasite occurring naturally in buffaloes which is transmissible to and pathogenic for cattle. Their main investigations on the adaptation of *T. parva* to splenectomized laboratory animals were completed, these attempts being uniformly unsuccessful, but experiments are continuing with rats and mice. Professor P. C. C. Garnham and Dr. R. Bray failed to infect splenectomized chimpanzees, mangabeys and rhesus monkeys with *T. parva* (Muguga) sent to them in Liberia.

Mr. Brocklesby and Mr. K. P. Bailey extended their studies on the chemotherapy of E.C.F. and established a standard method of assessing the efficacy of drugs against *T. parva* (Muguga). Further work was done on the efficacy of Terramycin in the E.A.V.R.O. method of immunization against E.C.F., the preliminary observations of last year being confirmed and extended.

Miss J. B. Walker's long-term studies on the systematics, distribution and biology of ticks have continued successfully, with primary emphasis on the genus *Rhipicephalus.* She has again given valuable and very welcome advice and assistance to officers in the territorial Veterinary and Game Departments on the identification and classification of ticks, particularly the rarer species. Miss Walker has participated for some years in a tick survey of Tanganyika, carried out by several

officers in the Veterinary Department. She is now collaborating with them in collating and preparing for publication the results of this important survey. Two of the officers who have played a leading part in the Tanganyika survey have recently retired, and it is essential that there shall be a permanent scientific record of their valuable investigations.

Dr. H. M. Martin of the University of Pennsylvania, who is working as a visiting scientist in E.A.V.R.O. on a financial grant from the U.S. National Institutes of Health, made good progress in his research on the growth of tick tissues in culture. It is hoped that this technique may be applied to his studies on the life-cycle of *T. parva* in the tick vector. The method of demonstrating parasites in the salivary glands of ticks is now used as a routine laboratory procedure in the Division.

The Division of Helminth Diseases continued research on the trematodes of livestock and their snail vectors. Dr. J. A. Dinnik and Mrs. N. N. Dinnik's researches on the paramphistomes or stomach flukes of East Africa, which have been carried out for several years, are being completed and the results published in a series of scientific papers. Their studies on liver flukes have included an investigation on the effects of temperature on the development of the flukes in snails, and laboratory experiments to determine whether *Lymnaea natalensis*, the common East African snail of this genus, can serve as a vector of *Fasciola hepatica*, the European liver fluke which is apparently becoming more widespread in Kenya: this fluke did not develop normally in *L. natalensis*. Dr. Dinnik continued his field investigation of aquatic habitats in the ecology and transmission of trematodes in Tanganyika, done in collaboration with the Veterinary Investigation Officer at Mwanza and the East African Medical Research Institute.

Dr. and Mrs. Dinnik are expanding their research on the morphology, systematics and life-cycles of schistosomes of ruminants, with primary emphasis on the *S. haematobium*-group. At the end of 1961, the World Health Organization made a grant of $5,000 towards this research, so as to enable them to take part in a world-wide co-operative project for research on bilharziasis of man and animals which is being organized and partly financed by W.H.O. This project will include laboratories in Britain, the U.S.A., Italy, Japan, the Philippines, South Africa and East Africa.

The Animal Production Division has again concentrated on research to elucidate the physiology, metabolism and genetics of indigenous Zebu cattle. In the Metabolism Section, Dr. A. Rogerson and Mrs. M. Lamb have obtained further valuable data on the energy metabolism and food utilization of cattle by the use of the E.A.V.R.O. closed circuit calorimeter, the first to be established for livestock research in tropical Africa. They are using the calorimeter for comparative studies on the energy balance of Zebu and Hereford steers on high, medium and low planes of nutrition under varying conditions of climatic stress. It is gratifying to record that the Animal Industry Research Co-ordinating Committee highly commended this research and congratulated Dr. Rogerson on establishing his calorimeter and operating it so successfully.

Mr. D. Robertshaw and Mr. R. Staple have carried out studies on the carbohydrate metabolism of indigenous and exotic cattle. Mr. Robertshaw has designed, and the E.A.V.R.O. workshop has built, a pair of parabolic reflectors for use in studies on the effects of solar radiation on cattle. This is an aspect of environmental physiology which has received insufficient attention in the past and which naturally cannot be studied in climatic chambers. It is anticipated that quantitative investigations on the equator at the altitude of Muguga should produce valuable and interesting new data on this component of climatic stress and heat tolerance. Comparative studies will be made on Zebu and exotic cattle and perhaps on other species of livestock.

Mr. G. H. Lampkin and Dr. K. Lampkin made sound progress in their long-term researches in the Genetics Section on the growth and production of beef-type indigenous Zebus and the inheritance of beef characteristics in these cattle. These important studies are now in the seventh year; 31 progeny groups have been formed and four others are being established, and the accumulation of data of many kinds continues steadily. The herds have been maintained entirely from the outset on grassland, no supplementary feeding being given, and consequently the work suffered a setback due to the severe and prolonged drought of 1960/61. However, 35 in. of rain fell at Muguga in November and December, the pastures improved rapidly and the genetics cattle soon showed substantial weight gains.

The abnormally heavy rains at the end of the year enabled large quantities of hay to be made at the beginning of 1962. This will restore the E.A.V.R.O. fodder reserves which had become seriously depleted in 1961.

E.A.V.R.O. Staff List for 1961

Director

H. R. Binns, C.M.G., O.B.E., M.A., B.Sc., M.R.C.V.S.

Deputy Director

(Vacant)

Research Officers

D. W. Brocklesby, M.R.C.V.S., Protozoology.
R. D. Brown, M.A., B.Sc., M.R.C.V.S., D.V.M. & S., Virology.
J. A. Dinnik, D.Sc., Helminthology.
R. N. Gourlay, B.Sc., M.R.C.V.S., Dip.Bact., Bacteriology.
*D. Horrocks, B.Sc., P.D., Biochemistry.
G. H. Lampkin, B.Sc., N.D.A., Dip.Anim.Gen., Genetics.
W. Plowright, M.R.C.V.S., Pathology.
D. Robertshaw, B.V.M.S., M.R.C.V.S., Physiology.
A. Rogerson, B.Sc., Ph.D., Biochemistry.
G. R. Scott, Ph.D., B.Sc., M.Sc., M.R.C.V.S., Virology.
Miss J. B. Walker, M.Sc., Entomology.

Laboratory Technicians

K. P. Bailey, Protozoology.
Mrs. N. N. Dinnik, M.Sc., Helminthology.
*R. D. Ferris, F.I.M.L.T., Virology.
*Mrs. J. Grote, Dip. A.M.T.A., Pathology.
D. Hay, F.I.M.L.T., Virology.
Mrs. M. Lamb, B.Sc., Biochemistry.
Mrs. K. Lampkin, B.Sc., Ph.D., Genetics.
A. K. MacLeod, A.I.M.L.T., Bacteriology.
Mrs. J. Palmer, Laboratory Animals.
Mrs. J. J. Palmer, Virology.
R. Palmer, A.I.M.L.T., Bacteriology.
C. S. Rampton, A.I.M.L.T., Virology.
L. W. Rowe, F.I.M.L.T., Virology.
Mrs. M. Robertshaw, Biochemistry.
Mrs. D. Staple, Virology.
R. Staple, A.I.M.L.T., Physiology.
Miss B. O. Vidler, Protozoology.

VISITING SCIENTISTS

*K. M. Cowan, Sc.D., M.S., A.B.
B. F. Cox, D.V.M.
W. Hess, Ph.D., M.S.
B. Liess, Dr.vet.med.
H. M. Martin, V.M.D., A.M., Ph.D.

GENERAL SERVICES

C. A. May, Maintenance Superintendent.
E. S. Palmer, Livestock Officer.
S. N. D'Souza, Storekeeper.
Mrs. L. D. Verdcourt, Librarian.

ADMINISTRATION

S. D. Coombes, Secretary.
Y. Kapoor, Accounts Officer.
Mrs. D. J. Plowright, Personal Secretary.
Mrs. J. W. Dent, Personal Secretary.
Mrs. G. G. MacLeod, Personal Secretary.

* Resigned or transferred during 1961.

E.A.V.R.O. Publications 1961

BARNETT, S. F. Connective tissue reactions in acute fatal East Coast fever (*T. parva*) of cattle. *J. infect. Dis., 107,* 253 (1960).

BROCKLESBY, D. W. *Cytauxzoon taurotragi,* a parasite of the eland. *Trans. R. Soc. trop. Med. Hyg., 55,* 10 (1961).

BROCKLESBY, D. W. *Cytauxzoon taurotragi,* the cause of a disease of the eland. *Res. vet. Sci.* (In press.)

BROCKLESBY, D. W. The febrile reaction in fatal East Coast fever. A review of 150 cases. *Bull. epiz. Dis. Afr.* (In press.)

BROCKLESBY, D. W. Amicarbalide in East Coast fever. *Vet. Rec.* (scientific letter), *73,* 1454 (1961).

BROCKLESBY, D. W. and BAILEY, K. P. Parthenogenesis not significant in the life cycle of the tick *R. appendiculatus. Bull. epiz. Dis. Afr., 9,* 157 (1961).

BROCKLESBY, D. W. and BAILEY, K. P. Oxytetracycline hydrochloride in East Coast fever (*T. parva* infection). *Brit. vet. J.* (In press.)

BROCKLESBY, D. W., BARNETT, S. F. and SCOTT, G. R. Morbidity and mortality rates in East Coast fever (*Theileria parva* infection) and their application to drug screening procedures. *Brit. vet. J., 117,* 529 (1961).

BROCKLESBY, D. W. and VIDLER, BRENDA O. Attempts to infect some small laboratory animals with *Theileria parva* I. *Res. vet. Sci., 2,* 285 (1961).

BROCKLESBY, D. W. and VIDLER, BRENDA O. Haematozoa of the blue wildebeest. *Bull. epiz. Dis. Afr., 9,* 245 (1961).

DARBYSHIRE, J. H., BROWN, R. D., SCOTT, G. R. and HUCK, R. A. A serological differentiation of rinderpest and bovine mucosal disease by agar gel diffusion. *Vet. Rec.* (scientific letter), *73,* 255 (1961).

DINNIK, J. A. *Paramphistomum daubneyi* nov. sp. from cattle and its snail host in the Kenya Highlands. *Parasitology.* (In press.)

DINNIK, J. A. and DINNIK, N. N. The growth of *Paramphistomum microbothrium* Fischoeder to maturity and its longevity in cattle. *Bull. epiz. Dis. Afr.* (In press.)

FERRIS, R. D. and PLOWRIGHT, W. The serial cultivation of calf kidney cells for use in virus research. *Res. vet. Sci., 2,* 387 (1961).

GOURLAY, R. N. Polysaccharide haptens from urine of cattle infected with *Mycoplasma mycoides. Nature, Lond.* (letter) (submitted).

HORROCKS, D. Sodium and potassium balance and growth of steers on high and low sodium diets. I.—Animals on low plane of nutrition. II.—Animals receiving concentrate feed. *J. agric. Sci.* (In press.)

HORROCKS, D. and PHILLIPS, G. D. Mineral balances in European and Zebu steers. *Brit. J. Nutrition.* (In press.)

HORROCKS, D. and PHILLIPS, G. D. The levels of some minerals in the alimentary tract of European and Zebu steers. *Brit. J. Nutrition.* (In press.)

MARTIN, H. M. and VIDLER, B. O. *In vitro* growth of tick tissues (*Rhipicephalus appendiculatus,* Neumann, 1901). *Exp. Parasit.* (In press.)

PLOWRIGHT, W. Application of monolayer tissue culture techniques in rinderpest research. I.—Introduction, use in serological investigations and diagnosis. *Bull. Off. int. Epiz.* (In press.)

PLOWRIGHT, W. Application of monolayer tissue culture techniques in rinderpest research. II.—The use of attenuated culture virus as a vaccine for cattle. *Bull. Off. int. Epiz.* (In press.)

PLOWRIGHT, W., CRUIKSHANK, J. G. and WATERSON, A. P. The morphology of rinderpest virus. *Virology.* (In press.)

PLOWRIGHT, W. and FERRIS, R. D. Studies with rinderpest virus in tissue culture. The stability of cultured virus and its use in virus neutralization tests. *Arch. ges. Virusforsch., 11,* 516 (1961).

PLOWRIGHT, W. and FERRIS, R. D. Studies with rinderpest virus in tissue culture. A technique for the detection and titration of virulent virus in cattle tissues. *Res. vet. Sci., 3,* 94 (1962).

PLOWRIGHT, W. and FERRIS, R. D. Studies with rinderpest virus in tissue culture. The use of attenuated culture virus as a vaccine for cattle. *Res. vet. Sci., 3* (1962).

SCOTT, G. R. and BROWN, R. D. Rinderpest diagnosis with special reference to the agar gel double diffusion test. *Bull. epiz. Dis. Afr., 9,* 83 (1961).

SCOTT, G. R., DETRAY, D. E. and WHITE, G. Rinderpest in pigs of European origin. *Amer. J. vet. Res.* (In press.)

SCOTT, G. R. and RAMPTON, C. S. Transmission of lapinized rinderpest virus by contact between rabbits. *Nature, Lond.* (letter) *192,* 289 (1961).

URQUHART, G. M. Epizootiological and experimental studies on bovine cysticercosis in East Africa. *J. Parasit., 47,* (6), 857 (1961).

WALKER, JANE B. Some observations on the classification and biology of ticks belonging to the genus Rhipicephalus, with special reference to the immature stages. *E.A. med. J., 38,* 232 (1961).

WHITE, G. and COWAN, K. M. Separation of the soluble antigens and infectious particles of rinderpest and canine distemper. *Virology* (letter). (In press.)

WITCOMB, M. A., PIERCY, S. E. and SCOTT, G. R. Mortality of fowl embryos inoculated with avianized strains of rinderpest virus. *Res. vet. Sci.* (submitted).

EAST AFRICAN TRYPANOSOMIASIS RESEARCH ORGANIZATION

DIRECTOR—W. H. R. LUMSDEN, D.Sc., M.B., CH.B., D.T.M., D.T.H.

The change in emphasis in research into the trypanosome diseases of Africa —sleeping sickness in man and nagana in cattle—has been described in recent reports. Briefly it is that until a few years ago only the eradication of tsetse flies appeared to hold out the promise of controlling these diseases. However, in much of Africa, eradication of tsetse flies is either very difficult or very expensive and this has prompted the exploration of other avenues of attack, notably concerted studies of several aspects of the disease so that the attempts to interrupt the cycles of transmission of trypanosomes may be as logically developed as possible; in the ultimate analysis it is the trypanosomes that are important not the tsetse flies.

The main lines of research at E.A.T.R.O. are concerned with acquiring better "tools" for the study of these diseases in nature. Particularly important have been the studies on the immune reactions of animals to trypanosome infection and on the infectivity of trypanosomes which have yielded methods with many practical applications. Also important are studies on the biting habits of tsetse flies in the field, to assess their importance as carriers of the disease, and on the biochemistry and physiology of trypanosomes so that the uses and limitations of the drugs, both curative and protective, may be understood.

The reorganization of E.A.T.R.O. is now practically complete. The new biochemistry laboratory and the central services for the preparation of apparatus have been in use for nearly a year. The new hospital is nearly finished; it will come into use in March, 1962, and will provide special facilities for work designed to improve the treatment of late stage cases which are still frequently incurable with present methods. With the completion of the hospital the opportunity for most kinds of trypanosomiasis research at E.A.T.R.O. will be unrivalled.

Although some difficulty with recruitment of staff continues, a Veterinary Research Officer and two Laboratory Technicians were acquired in 1961, leaving vacancies only of one Medical Research Officer and one Biologist.

The following visiting scientists worked at E.A.T.R.O. during 1961:—

Dr. F. Hawking, National Institute of Medical Research, seven weeks; chemotherapy of trypanosomes.

The late Emeritus Professor R. M. Gordon, O.B.E., Liverpool School of Tropical Medicine, four weeks; transmission of trypanosomes and development of the infection in the mammal host.

Professor D. L. Lehmann, University of the Pacific, California, two months; application of culture methods for the recognition of trypanosome species.

Dr. D. Weinman, Yale University, two and a half months; use of trypanosome culture for diagnosis and study of the factors determining the infectivity of cultures.

Dr. D. S. Saunders, University of Edinburgh, four months; age estimation of *Glossina* in the field.

In 1961, nine students from Makerere College worked at E.A.T.R.O. during their vacations.

The Director was invited by the organizers of the Tenth Pacific Science Congress in Honolulu to give two papers, on the organization of research and on trends in trypanosomiasis research in Africa.

Research

A great deal of long-term routine work has continued, the present summary will mention only main points and recent advances of particular interest.

Isolation and preservation of trypanosome strains.—The new method for the preservation of the trypanosomes recently developed at E.A.T.R.O. has now become routine procedure. Capillary tubes are used and large numbers of standard strains can be preserved in small space. We now receive requests for supply of this material to many other laboratories, particularly in Europe. This extends widely the possibilities of pertinent research in specialist laboratories outside Africa; instead of, as in the past, a few institutes working on unrepresentative old laboratory strains, there are now many institutes working with recently isolated material and dealing with many aspects of study, immunological, biochemical, chemotherapeutic, etc.—in London, Liverpool, Basle, Amsterdam, Pretoria and so on. This development derives directly from the supply of material by E.A.T.R.O.

Trypanosome handling.—Besides supplying standard frozen material to other institutes E.A.T.R.O. itself has not been behindhand in exploiting that material, mainly by applying modifications of virological techniques to it. Essentially what has happened in this field at E.A.T.R.O. is a change towards an experimental emphasis. Already many matters which have been controversial are known definitely and precise quantitative studies are continuing on many aspects of trypanosome behaviour—infectivity, drug sensitivity, metabolism—which are essential for the proper understanding of the relationship between the parasites and their hosts, both mammal and insect. A most important advance in this field has been a demonstration of the importance of precise control of the acidity of the fluid in which trypanosomes are suspended if their infectivity is to be maintained. Infectivity falls off extremely rapidly in even slightly acid fluids. As conclusions as to the immunity of animals, or as to the activity of drugs in animals, were often based on the results of test inoculations of trypanosomes, this discovery is of vital importance and will necessitate the re-assessment of much previous work.

Other important studies in this field have been—

The effect of antibiotics on trypanosomes has been examined and it has been found that penicillin, streptomycin, terramycin, and polymyxin are without effect so that their use opens a field of experimentation in which bacterial activity is controlled by these antibiotics to allow study of long-term effects of various materials or treatments on trypanosomes.

The infectivity of trypanosomes has been compared with the number of trypanosomes present and it has been found that loss of infectivity often precedes any marked reduction in trypanosome numbers.

The relative efficiency of cultures and mice for the diagnosis of trypanosome infections in man and animals has been compared.

Immunology.—Most of the work has been on the development of the agglutination test for the recognition of anti-trypanosome substances in the blood of hosts. Recent work has been directed towards the following of the development of these substances during the infection both in cattle and laboratory animals. The method has been improved and speeded up so that large numbers of specimens can now be tested quickly. It has been found that the amounts of anti-trypanosomal substances rise rapidly after infection and that they can be detected within a few days. The method is now being applied in cattle to study the changes

taking place in trypanosome type over a period of many months—the trypanosomes are isolated from the animals from time to time and stored, deep frozen, for their immunological constitution to be determined later.

A very promising development from this work is the demonstration that antitrypanosomal substances can be recognized in the blood meal of tsetse flies and of other blood-sucking insects. For a long time it has been possible to identify the species of animal bitten by an examination of the blood meal of the fly; with this new development it will be possible to combine these two pieces of information. In other words, instead of having to shoot wild animals to find if they are infected with the disease being studied, it will be possible to use the flies to collect samples of blood for examination. This principle is likely to be applicable to many diseases in which wild animal hosts are important.

Ecology of human trypanosomiasis.—In North Nyanza, Kenya, the resources of E.A.T.R.O. were deployed in collaboration with the Division of Insect-borne Diseases of the Kenya Medical Department in the study of a sleeping sickness outbreak. One of the difficulties in studying outbreaks of this sort is that of recognizing all the infected people by routine blood examinations. The numbers of trypanosomes in the blood may be so small that trypanosomes are missed by microscopical examination; but there may still be sufficient to infect flies and so encourage the outbreak to continue. Also, failure to diagnose the disease in its early stage may result in patients progressing into the later, often fatal, stage of the disease. In North Nyanza E.A.T.R.O. experimented with the use of inoculation into mice and into culture as improvements in the method of diagnosis; by both these means cases were discovered which had escaped detection by microscopical examination. From this outbreak many strains of trypanosomes were isolated from patients and stored for subsequent examination. Also, by an application of the improved handling methods mentioned earlier in the report it was possible to process very large numbers of flies to search for trypanosomes in them in the area of the outbreak; eleven trypanosome strains were recovered from flies and are now under further study.

Ecology of animal trypanosomiasis.—For the logical development of preventive measures against animal trypanosomiasis much more precise information on the tsetse and other insect attack on cattle is needed—much of the work on tsetse in the past was based on methods which were not well adapted to this purpose. A series of catches on cattle as "bait", in various environments, is now building up the kind of information needed.

The three species of tsetse (*Glossina*) in Busoga have different attack patterns —*G. pallidipes* is diurnally active with a peak usually in the late afternoon, *G. palpalis* exhibits an even "plateau" of activity during the day and *G. brevipalpis* is active at dawn, dusk and through the night. Wide differences, as yet unexplained, exist in the degree of tsetse attack on animals between apparently similar locations. Coat colour of cattle has also been found to be important in relation to the degree of attack. Patterns of activity of other biting flies, particularly *Stomoxys* and *Tabanus*, are also included in the studies as these insects are likely to be important in transmission of trypanosomes within the herd. Identification of blood meals has shown that *G. pallidipes* feeds mainly on ungulates while *G. brevipalpis* divides its attention between ungulates, wild pigs and hippopotamus.

With the recent arrival of a second Veterinary Research Officer it is planned to concert this work with the identification of trypanosome strains in cattle, to compare these strains with those found in flies and wild animals, and to study the pathology of the disease in animals, and its chemotherapy.

Biochemistry.—The method at present available for the identification of blood meals of tsetse suffers from the disadvantage that a long delay is inevitable, as the meals have to be sent to the United Kingdom, so that the results cannot be used immediately to direct work in progress. An electrophoretic method of identifying blood meals, which is quick and applicable where closely allied species need not be distinguished, has been developed and seems likely to be of use for this purpose.

Laboratory Transmission.—The impetus given to trypanosome studies widely in the world as a result of the supply by E.A.T.R.O. of frozen blood forms of trypanosomes has been referred to above. It has also been shown at E.A.T.R.O. that the infective forms in the fly may be preserved in the same way, and attempts are being made to produce these forms in large numbers.

Tsetse Colony.—The development of accurate methods of estimating the age of insects in the field has shown to be important in many fields of tropical medicine and veterinary parasitology. Work on this matter in relation to tsetse has been carried out by a visiting worker in collaboration with an E.A.T.R.O. Research Officer. Very good correspondence has been obtained between marked flies of known age and the age estimation; flies can now be aged accurately within a few days up to as much as 50 days old.

E.A.T.R.O. Staff List as at 31st December, 1961

Director

Dr. W. H. R. Lumsden, D.Sc., M.B., Ch.B., D.T.M., D.T.H.

Research Officers

Dr. D. H. H. Robertson, M.B., Ch.B., D.T.M. & H., M.R.C.P.(Ed.), Medical Research.
Mr. M. P. Cunningham, M.R.C.V.S., Veterinary Research.
Mr. H. A. W. Southon, M.A., Entomology.
Mr. J. M. B. Harley, B.Sc., Entomology.
Dr. R. H. Knight, B.Sc., Ph.D., Biochemistry.
Dr. W. A. F. Webber, B.Sc., Ph.D., Protozoology.
Mr. K. van Hoeve, med.vet.drs., Veterinary Research.

Laboratory Staff

Mr. C. J. Webb, A.I.S.T., A.I.B.P., A.R.P.S., Laboratory Technician.
Mr. E. B. Grainge, A.I.S.T., Laboratory Technician.
Mr. K. L. Cockings, Laboratory Technician.
Mr. K. C. Humphryes, Laboratory Technician.
Mr. B. C. Hawgood, A.I.M.L.T., Laboratory Technician.

Administration and General Services

Mr. J. S. McClay, M.A., Secretary.
Mr. G. J. Rankin, D.D.A., Livestock Officer.
Mr. P. R. Petersen, Maintenance Superintendent.
Mr. K. C. Trivedi, Accounts Officer.

E.A.T.R.O. Publications, 1961

Bursell, E. (1961). The behaviour of tsetse flies (*Glossina swynnertoni* Austen) in relation to problems of sampling. *Proc. R. ent. Soc. Lond.* (*A*)., *36,* 9-20.

Bursell, E. (1961). Post-teneral development of thoracic musculature in tsetse flies. *Proc. R. ent. Soc. Lond.* (*A*)., *36,* 69-74.

CAWDERY, M. J. H. and KNIGHT, R. H. (1961). A new method for the administration of trypanocidal drugs to animals. *Vet. Rec., 73,* 982-983.

CUNNINGHAM, M. P. and HARLEY, J. M. B. Preservation of living metacyclic forms of the *T. brucei* Group. *Nature, Lond.*

CUNNINGHAM, M. P., HARLEY, J. M. B., SOUTHON, H. A. W. and LUMSDEN, W. H. R. The detection of antibodies in part-digested blood meals of haematophagous arthropods. *Science.*

CUNNINGHAM, M. P. and VICKERMAN, K. (In press.) Antigenic analysis of trypanosomes of *brucei* group using the agglutination reaction. *Trans. R. Soc. trop. Med. Hyg.*

GLASGOW, J. P. (1961). The feeding habits of *Glossina swynnertoni* Austen. *J. Anim. Ecol., 30,* 77-85.

GLASGOW, J. P. (1961). Selection for size in tsetse flies. *J. Anim. Ecol., 30,* 87-94.

GLASGOW, J. P. (1961). Ecological effects of tsetse fly control in particular as a consequence of bush clearing. *Proc. 8th Technical Meeting, Int. Union Conserv. Nature Nat. Res. Symposium,* Warszawa, 85-92.

GLASGOW, J. P. (1961). Seasonal changes in the breeding places of *Glossina morsitans morsitans* Westwood. *Acta tropica, 18,* 250-254.

GLASGOW, J. P. (In press.) Seasonal variations in size and colour, and daily changes in the distribution of *Glossina pallidipes* Aust. in the South Busoga forest. *Bull. ent. Res.*

GLASGOW, J. P. and DUFFY, B. J. (In press.) Traps in the field studies of *Glossina pallidipes* Austen. *Bull. ent. Res.*

GLASGOW, J. P. and GLASGOW, S. (In press.) Histology of the growth of flight muscles in *Glossina. Proc. R. ent. Soc. Lond. (A).*

GLASGOW, J. P. and WELCH, J. R. (In press.) Long-term fluctuations in numbers of the tsetse fly *Glossina swynnertoni* Aust. *Bull. ent. Res.*

HARLEY, J. M. B. Natural hosts of *Glossina. Proc. 11th Int. Congr. Entom.*

HARLEY, J. M. B. and PILSON, R. D. (1961). An experiment in the use of discriminative clearing for the control of *Glossina morsitans* Westw. in Ankole, Uganda. *Bull. ent. Res., 52,* 561-576.

ISHERWOOD, F., DUFFY, B. J., GLASGOW, J. P., LEE-JONES, F. and WEITZ, B. (In press.) Further studies of the food of tsetse flies. *J. Anim. Ecol.*

LEHMANN, D. L. (1961). Some culture differences between *T. rhodesiense* and *T. brucei* in autoclaved diphasic media. *Ann. trop. Med. Parasit., 54,* 419-427.

LEHMANN, D. L. Attempts at the selective cultivation of *T. rhodesiense, T. brucei* and *T. congolense. Ann. trop. Med. Parasit.*

LEHMANN, D. L. Diagnostic effects of osmotic pressure and suramin upon cultures of *Trypanosoma congolense* and *T. rhodesiense. Ann. trop. Med. Parasit.*

LUMSDEN, W. H. R. Recent trends in trypanosomiasis research in Africa, relevant to problems in the New World. Paper for *Tenth Pacific Science Congress*, Hawaii, August, 1961.

LUMSDEN, W. H. R. The organization and orientation of applied research in under-developed areas. Paper for *Tenth Pacific Science Congress*, Hawaii, August, 1961.

MANUELIDIS, E. E., ROBERTSON, D. H. H., AMBERSON, J. M. and HAYMAKER, W. Neuropathology features of *T. rhodesiense* infection with comparison with the changes in *T. gambiense* infection. *Transactions, Munich Congress*, September, 1961.

RENNISON, B. D. and SMITH, I. M. (1961). Studies of the sampling of *Glossina pallidipes* Aust. 4.—Some aspects of the use of Morris traps. *Bull. ent. Res.*, *52*, 609-619.

ROBERTSON, D. H. H. (1961). The stonefish—*Synanceja verrucosa*. *E. Afr. med. J.*, *38*, 369-373.

ROBERTSON, D. H. H. (1961). Nitrofurazone-induced haemolytic anaemia in a refractory case of *T. rhodesiense* sleeping sickness. The haemolytic trait and self-limiting haemolytic anaemia. *Ann. trop. Med. Parasit.*, *55*, 49-63.

ROBERTSON, D. H. H. (1961). The haemolytic effect of primaquine and nitrofurazone in cases of sleeping sickness with the haemolytic trait. *Ann. trop. Med. Parasit.*, *55*, 278-286.

ROBERTSON, D. H. H. (In press.) Chemotherapy of African trypanosomiasis. *Practitioner*.

ROBERTSON, D. H. H. and KNIGHT, R. H. Observations on the polyneuropathy and the disordered pyruvate metabolism induced by nitrofurazone in cases of sleeping sickness. *Ann. trop. Med. Parasit.*

SMITH, I. M. and RENNISON, B. D. (1961). Studies of the sampling of *Glossina pallidipes* Aust. 1.—The numbers caught daily on cattle, in Morris traps and on a fly-round. *Bull. ent. Res.*, *52*, 165-182.

SMITH, I. M. and RENNISON, B. D. (1961). Studies of the sampling of *Glossina pallidipes* Aust. 2.—Daily pattern of flies caught on cattle, in Morris traps and on fly-round. *Bull. ent. Res.*, *52*, 183-189.

SMITH, I. M. and RENNISON, B. D. (1961). Studies of the sampling of *Glossina pallidipes* Aust. 3.—The hunger stages of male flies caught on cattle and in Morris traps. *Bull. ent. Res.*, *52*, 601-607.

SMITH, I. M. and SCOTT, W. N. (1961). Chemoprophylaxis against bovine trypanosomiasis. III.—The cure of infected cattle removed from a high tsetse density. *J. Comp. Path.*, *71*, 325-342.

SOUTHON, H. A. W. and ROBERTSON, D. H. H. (1961). Isolation of *T. rhodesiense* from wild *Glossina palpalis*. *Nature, Lond.*, *189*, 411-412.

WEBB, C. J. One-step reproduction of electropherograms in agar gel with auto-positive film. *J. Inst. of Science Technology*.

LUMSDEN, W. H. R. Recent trends in trypanosomiasis research in Africa, relevant to problems in the New World. Paper for *Tenth Pacific Science Congress*, Hawaii, August, 1961.

LUMSDEN, W. H. R. The organization and orientation of applied research in under-developed areas. Paper for *Tenth Pacific Science Congress*, Hawaii, August, 1961.

MANUELIDIS, E. E., ROBERTSON, D. H. H., AMBERSON, J. M. and HAYMAKER, W. Neuropathology features of *T. rhodesiense* infection with comparison with the changes in *T. gambiense* infection. *Transactions, Munich Congress*, September, 1961.

RENNISON, B. D. and SMITH, I. M. (1961). Studies of the sampling of *Glossina pallidipes* Aust. 4.—Some aspects of the use of Morris traps. *Bull. ent. Res.*, *52*, 609-619.

ROBERTSON, D. H. H. (1961). The stonefish—*Synanceja verrucosa*. *E. Afr. med. J.*, *38*, 369-373.

ROBERTSON, D. H. H. (1961). Nitrofurazone-induced haemolytic anaemia in a refractory case of *T. rhodesiense* sleeping sickness. The haemolytic trait and self-limiting haemolytic anaemia. *Ann. trop. Med. Parasit.*, *55*, 49-63.

ROBERTSON, D. H. H. (1961). The haemolytic effect of primaquine and nitrofurazone in cases of sleeping sickness with the haemolytic trait. *Ann. trop. Med. Parasit.*, *55*, 278-286.

ROBERTSON, D. H. H. (In press.) Chemotherapy of African trypanosomiasis. *Practitioner*.

ROBERTSON, D. H. H. and KNIGHT, R. H. Observations on the polyneuropathy and the disordered pyruvate metabolism induced by nitrofurazone in cases of sleeping sickness. *Ann. trop. Med. Parasit.*

SMITH, I. M. and RENNISON, B. D. (1961). Studies of the sampling of *Glossina pallidipes* Aust. 1.—The numbers caught daily on cattle, in Morris traps and on a fly-round. *Bull. ent. Res.*, *52*, 165-182.

SMITH, I. M. and RENNISON, B. D. (1961). Studies of the sampling of *Glossina pallidipes* Aust. 2.—Daily pattern of flies caught on cattle, in Morris traps and on fly-round. *Bull. ent. Res.*, *52*, 183-189.

SMITH, I. M. and RENNISON, B. D. (1961). Studies of the sampling of *Glossina pallidipes* Aust. 3.—The hunger stages of male flies caught on cattle and in Morris traps. *Bull. ent. Res.*, *52*, 601-607.

SMITH, I. M. and SCOTT, W. N. (1961). Chemoprophylaxis against bovine trypanosomiasis. III.—The cure of infected cattle removed from a high tsetse density. *J. Comp. Path.*, *71*, 325-342.

SOUTHON, H. A. W. and ROBERTSON, D. H. H. (1961). Isolation of *T. rhodesiense* from wild *Glossina palpalis*. *Nature, Lond.*, *189*, 411-412.

WEBB, C. J. One-step reproduction of electropherograms in agar gel with auto-positive film. *J. Inst. of Science Technology*.

EAST AFRICAN FRESHWATER FISHERY RESEARCH ORGANIZATION

General

The staff position at the close of the year is shown at the end of the report. Mr. D. J. Garrod proceeded on U.K. leave in May, and resigned in November. His vacancy is not yet filled.

Mr. J. D. Roberts was promoted to a new C.1 Scale post of Experimental Fisheries Officer, in July, 1961, and it was possible to upgrade Mr. Pragji Mesvania to the grade of Foreman Artisan also in July.

The vacant post of Senior Field Officer (Laboratory, Stores and Housing) was filled by the appointment of Mr. R. I. M. Baxter, formerly of the Uganda Tsetse Control Department, in September.

Mr. E. L. Hamblyn has been on detachment at Butiaba on Lake Albert for much of the year on the Nile perch investigation, but had to withdraw from there in November and evacuate all the equipment because of the tremendous rise in level of Lake Albert which threatened to swamp the store and laboratory hut he had been using. He is now stationed at Headquarters in Jinja once more, engaged on writing up his results.

No. 1 launch was out of commission for over a month in June, as an unfortuate accident stripped both propellers on a sunken reef off Dagusi Island in late May. Opportunity was however taken to order and refit two new propellers of slightly different pitch ordered by air from U.K. which are more efficiently suited to the two Perkins S.6M diesel engines with which the launch is powered, and the improvement in her performance is marked. This launch ran some 4,600 miles on duty during the year.

No. 2 launch has given continuous trouble-free service throughout the year, apart from the usual maintenance slipping for repainting, running some 20 hours on duty, mainly on local trips of very short duration.

During the year an additional grant was obtained from C.D. & W. sources to assist in maintenance of the eight staff houses, laboratory building, workshop and aquarium, together with the erection of a small museum to house specimen collections and display work in progress. A further survey of the structure of the buildings by the High Commission Property and Maintenance Officer has however indicated that the fabric of the Laboratory, Aquarium and houses is in a much worse state with subsidence and termite damage than was at first realized, and there is no doubt that the wear and tear of a tropical environment for 15 years, coupled with bad initial construction, is now going to be a much more expensive business to rectify than at first estimated.

It has been possible however to construct several useful additions to the working facilities during the year, notably a waterproof cabinet for the Mettler Balance in the fish room and a properly paved courtyard on which the numerous outside experimental aquaria are now raised on Dexion stands, making for much cleaner and more efficient working. Repainting of Laboratory and houses has been completed throughout, resulting in a fresher and more cheerful appearance.

The work in the Library by Mr. Elder and Mrs. Kemp has resulted in the establishment of first-class working and reference facilities, but much still remains to be done. The rising cost of periodical subscriptions, volume binding, additional shelving, etc., all exceed the Library expenditure which has been pegged at £200 for several years, and application has been made for capital to other sources to

improve the financial position; no sum is yet available. The Library facilities are immensely important, since this is now practically the only comprehensive hydrobiological Library, south of the Sahara, still in working condition.

Dr. and Mrs. J. F. Talling completed their year's visiting work and returned to the F.B.A. Laboratories in England in early September. Their contribution to an understanding of the hydrology and algology of Lake Victoria has been outstanding. They were also able to accomplish an astonishing amount of work on Lake Albert and the Lakes of Western Uganda, and analyse samples from Ethiopia, Tanganyika, Kenya and the Federation, in addition.

There was the usual number of distinguished visitors to the Laboratory during the year, and we were especially pleased to be able to assist Prof. H. Heller of the University of Bristol for a few days with the collection of pituitaries from *Protopterus* and *Polypterus* on which he is carrying out chromatographic studies.

Scientific Work of the Organization

Fisheries of Lake Victoria

At the time of writing, it has not been possible to complete the normal six-monthly analyses of commercial statistics, even for the first part of 1961 under review. The Uganda records are complete only up to March, though the full year's results are to hand from Kenya and Tanganyika recording stations.

Up to the end of 1960, however, the records showed no substantial change which would necessitate revision of advice put forward earlier on the need to reimpose control, in order to stabilize the fisheries and obtain an optimum sustainable yield, instead of a yield which fluctuates and causes fishermen to move from inshore to offshore and *vice versa*.

In Uganda waters the general conclusions to be drawn from analyses of landings is that in some areas the fish stocks may be recovering as a result of the reduction in fishing effort when fishing became uneconomical three years ago. Nevertheless the figures show that the yield is not yet as great as when 5 in. nets were in use; and if 4½ in. nets continue in use, there may be an increase in fishing effort in this area which will prevent a full recovery.

In spite of a low catch per net when 5 in. nets only were in use prior to 1957, it is now known that the fish stocks were actually under-exploited. However, the subsequent use of smaller meshes has led to overfishing, and in the areas recorded the yield will never be substantially greater than when 5 in. nets were in use, but the basic stocks of fish have been seriously reduced. There is no doubt that a much better yield would have been obtained by increased fishing with 5 in. nets, instead of reducing mesh size in an effort to maintain yield. It is known that *T. variabilis* is caught in greater numbers in 4½ in. mesh nets, and at Bukakata for example where the numerical yield is equal to that obtained in 1955, prior to derestriction, this is because of the increased catches of this species which have offset the decline in *T. esculenta* catches; but whereas in 1955 the total catch was valued at Sh. 31,659, in 1960 approximately the same catch was valued at Sh. 18,398 only, because the weight and value of *T. variabilis* from 4½ in. nets is less than that of *T. esculenta*. This does not appear an economic advance in any way, especially in view of the damage done to the basic fish stocks which results from such use of small mesh nets.

In Kenya waters, there was a particularly strong year class of *T. esculenta* entering the fishery, as had been forecast in the previous Annual Report, which enabled a temporary improvement to take place in some areas of the Gulf fisheries. Outside the Gulf, the 4½ in. net records now show that, as had been

predicted by E.A.F.F.R.O., there are no substantial reserves of other species which would offset the damage to *T. esculenta* fisheries which is inevitable when $4\frac{1}{2}$ in. net fishing is intensive.

In Tanganyika waters the catch per net is still declining in all areas, but here the retail price of fish is lower than elsewhere and the fishermen tend to move before the stocks become as seriously depleted as in other parts of the Lake.

During the year, it has been noted that offshore fisheries have increased, but neither the territorial departments, nor E.A.F.F.R.O., have any statistics to show if the development of these has been adequate to offset losses from declining catches inshore, and it is vital to obtain further data on this. It can be nothing short of disastrous however to fish new areas with $4\frac{1}{2}$ in. nets only, and it must be realized that a mesh which returns the maximum catch of fish is by no means the optimum net to use, if the yield is to be sustained. This cannot be emphasized too strongly in view of recent developments to open up further areas to fishing.

As a corollary to this general analysis of commercial returns, Mr. Garrod also during the year completed three years' intensive study of a "unit" fishery in the N. Buvuma area, which is known to be reasonably self-contained and unaffected by migration of fish.

From the examination of several thousand fish at weekly intervals at Waigalla landing, it has been possible to calculate the basic parameters of fish growth, fishing effort, natural and fishing mortality, fecundity and net selectivity, and combine them into a mathematical model which not only shows the existing state of the fishery, but enables forecasts to be made of the effect of varying the effort and mesh. This has proved extremely accurate when checked against known landings, and for the first time for any tropical freshwater fishery, has enabled a rational method of exploitation to be proposed in order to obtain an optimal sustainable yield from such a fishery.

It should, however, also be realized that if this rational technique is adopted, there would, firstly, be a temporary decline in catches while stocks adjusted themselves to the new equilibrium; and secondly, that while the overall total yield would be greater with the increased effort, there would also, as a corollary, be a lower catch per net. Thus though the total income of fishermen as a group would be greater, any individual fisherman's profit would be less. An increase in the price of fish to the fishermen would offset the latter and also cover increased capital cost of the additional nets required, while the formation of co-operatives could spread the overall greater profit more evenly.

These proposals apply only to the *Tilapia esculenta* stocks in this area, but since there is no reason to suppose that the biology of this species varies markedly from place to place on the Lake, these recommendations may also be applicable to other unit fishery areas of Lake Victoria as well. There is a physical limitation on the number of nets which can be fished from each type of canoe in use, hence it is also possible to control the effort to a great extent by a canoe licensing system, which in effect will impose a limitation on the number of nets which can be fished from any one landing area.

The records since de-restriction have shown in fact that the major damage to the stocks occurred as a result of increase in effort with small mesh nets. These smaller mesh nets inevitably caught more fish than the 5 in. nets, since they were exploiting a hitherto untouched source of smaller size groups of fish; and because more fish could be landed, more fishermen were induced to fish. The fishery in Lake Victoria is unique in the fact that fish are sold by numbers rather than by weight, and hence the usual economic brakes did not apply when these greater

numbers of smaller fish were landed, and no price check resulted from the increase in numbers of fishermen. Thus, at least effort control must at first be reimposed, and this must then be coupled with a return to larger meshes and a revision of marketing practice. Only thus could the fishery again be stabilized at sustainable maximum productivity.

The use, however, of any nets smaller in mesh than 4½ in., in any proportion whatever, would be disastrous in its destruction of breeding stock. For a short period at the end of 1960, 4 in. net catches were recorded in Kenya waters, and these showed catches of up to ten fish per net. Coupled with seining which also takes place in these waters, the destruction of small breeding fish by such methods is far more than the stocks will ever stand.

It should be noted that in a fishery for such mouth-brooding *Tilapia,* one of the major curbs to the successful continuance of unrestricted fishing is the limited density dependent survival ability of restricted brood sizes. A mouth-brooder can only incubate a few hundred eggs and fry in the female's mouth, and since *T. esculenta* very rarely grow above 35 cm., there is obviously a low upper limit to the number of fry which can survive at each spawning—an upper limit which is far less than in the random pelagic or demersal spawning fish which form the basis of great marine fisheries. The efficiency of the mouth-brooding habit itself imposes a limitation on the number of fry which can survive in any one stock of fish, in spite of a higher spawning frequency, and predation by man can reach levels far above the biological capabilities for recruitment of such fish.

In this connexion, the data analysed by Garrod have shown that any question of maintenance of even this one small area by artificial stocking is economically impractical; the mortality calculations show that over 300 million fry a month would be required to maintain the stock at its present level of exploitation, and the pond area required for this is prohibitively large.

Other Species of *Tilapia*

It has not yet been possible fully to analyse the progress of the other species of *Tilapia* introduced in the last few years. *T. nilotica* are still a rarity; *T. zillii* are forming a small but significant percentage of inshore water catches only. In the N. Buvuma area, catches of these valued £752 in the early months of 1961, but there is no distinct upward trend in the catches of this species in this area sufficient to offset the loss of *T. esculenta.* It is disappointing to report moreover that this species is not showing the promise of early introductions as far as size attained is concerned. The most suitable gear for cropping this species appears now to be 4 in. nets, and the use of this size mesh should be out of the question.

The only introduced *Tilapia* for which sufficient recapture data are available for calculation of growth rate is *T. leucosticta.* Garrod has analysed the data available by the technique developed by Gulland and Holt, and has shown that there is a sexual dimorphism in growth, males reaching a maximum size of 30.5 cm. and females 28.0 cm. These again are lengths more suitable for exploitation by gear less than 5 in. mesh.

The results from Dr. Fryer's study of *T. variabilis* are now available. These have shown that this species again is most suitably exploited by 4½ in. nets, is extremely slow growing, and probably would not stand heavy exploitation. It is moreover a fish of less value than *T. esculenta* because of its inferior keeping qualities. This study brought out most clearly the astonishing homing ability of this species to its breeding beaches. Some of Dr. Fryer's marked fish are still being returned, over two years after first marking, and almost always from the area in which they were tagged as breeding fish. This aspect of their behaviour

will be the subject of special study in 1962 by an American worker from Prof. Hasler's laboratory in Wisconsin, where fish orientation and homing studies are a particular subject of investigation.

Small-mesh Gill Net Fisheries

In Tanganyika waters in particular, small-meshed gill net fisheries are more widespread than elsewhere, but the records for *Synodontis* fisheries show indecisive trends because records were organized properly only in 1958; but although catches are good at some landings, the catch per net has fallen and the usual disturbing tendency to use smaller mesh nets is evident as fish become scarcer.

However, where sufficient data are available, the most serious trend discernible is the decline of the important *Labeo victorianus* fishery, which in some areas has ceased altogether as being uneconomic even for African fishermen. Aggregated data for all *Labeo* fisheries show a decline in catch per net from a peak of 7.3 in 1954 to 0.9 in 1960, and the Kagera River area in particular has shown a very marked decline. It would be difficult to refute the suggestion that this is again due to uncontrolled overfishing, especially in the Kagera area where the fish are caught on their upstream spawning migration by the peculiarly deadly technique of floating gill nets down the river Biological data on growth, fecundity, survival, etc., of this species are, however, too scanty to enable any estimate to be made of true productivity and yield obtainable, but the present facts of species density —as indicated by catch per net—are sufficient to cause concern as to its future as a major component of Victoria fisheries.

Bagrus Investigation

Bagrus docmac continues to be the object of a fishery of great importance on the Lake. Mr. Elder has continued his studies on this species throughout the year, emphasis being on its role as one of the major predators on the *Haplochromis* stocks in Victoria, which indeed form its food almost exclusively. *Haplochromis,* which have been described as "useless" fish because of their small size, are thus nevertheless the indirect basis of a very large and valuable fishery and are very far from useless and unexploited.

The main work of collection of material in the field has now been completed, although it is hoped to continue the monthly sampling of commercial catches until June, 1962, when this officer is due to go on home leave. The analysis of collected material for age, growth, fecundity, and the observations on ecology, should be complete by June, 1962.

Commercially, *Bagrus* is the most important "non-cichlid" fish in Lake Victoria, forming approximately one-sixth of the total yearly yield from the Lake. This is a remarkable fact, considering that *Bagrus* is a piscivorous predator. Since it depends largely on the *Haplochromis,* it was thought worthwhile to investigate some of the relationships between predator and prey, in order to establish the impact of predation of *Bagrus* on these *Haplochromis* stocks.

Experiments were therefore started in April to study the controlled growth of *Bagrus* under aquarium conditions. A technique was evolved for force-feeding the fish under water, the fish being held in a net at the surface of the water.

Present evidence indicates that *Bagrus* locates its prey probably by chemotactile perception, and that it feeds nocturnally while the prey fish are asleep. In daylight hours it remains inactive and hides under objects away from the light. Accordingly, the experimental fish were fed after dark, and were provided with cover during the day.

In the first part of these experiments, fish over a wide size range were kept for periods ranging from three to seven months, and were fed at rates just sufficient to maintain them at a constant weight. This showed that the smaller fish require relatively more food than the larger. Thus at the extreme sizes of *Bagrus* investigated, it was found that a fish of 65 gm. total weight required 90 milligrams of prey per gram body weight per week, while one of 940 gm. total weight required only 25 milligrams.

The plot of total body weight against the milligrams of prey required per week per gram body weight of the predator is a function of the metabolic rate, and the curve so obtained, over the range investigated, is in form similar to, and probably related to, the asymptotic growth curve. These findings are of fundamental importance in consideration of predator/prey relationships, since clearly the age structure of a given predator population has an important bearing on the predation pressure which that population exerts.

In the second part of the experiments, *Bagrus* were kept in conditions ranging from complete starvation to feeding at rates probably in excess of anything achieved under natural conditions. These have shown that for any given fish the metabolic rate varies directly with the feeding rate, and seems to be independent of the condition factor of the fish. There is some indication that the metabolic rate of a starved fish decreases logarithmically, but consistent results have not yet been obtained.

A third part of the experiments on the growth of *Bagrus* under different temperature conditions has just been completed, while experiments on the growth of fish kept artificially active, and more direct estimates of metabolic rate by rate of oxygen uptake, are still in progress.

These can be expected to establish the parameters within which the normal growth and feeding rate of *Bagrus* in Lake Victoria lie, and hence a rational estimate of its role as an existing predator on the population of *Haplochromis* already in the Lake. It will be recalled that suggestions have already been made by Uganda authorities that these *Haplochromis* populations might form the food basis for an exotic predator, the Nile perch, *Lates*, whose introduction has been proposed. This Organization has always advocated a policy of caution with regard to this, and a thorough investigation of all aspects before any deliberate steps are taken. This study of *Bagrus*, an important predator already in the Lake, is one aspect of such an investigation, since it appears quite possible that the abundance of *Bagrus* itself, an important food fish for man, may in fact be limited by the stocks of *Haplochromis*, in spite of the apparent density of the latter. Nor must it be forgotten that there are several other predatory fish in the Lake already, such as *Clarias mossambicus*—again an important food fish for man—and several of the *Haplochromis* species themselves. In addition to these facts, it is probable that the present shoals of *Haplochromis* play a large part in the cycle of nutrient material in the Lake, a feature of major importance where the prime crop is composed of herbivores such as the *Tilapia* species.

Lates INVESTIGATION

However, the other aspect of such an investigation is equally clearly a study of *Lates* as it occurs in its natural environment elsewhere and accumulation of as much data as possible on its biology.

This investigation is being carried out by Mr. E. L. Hamblyn, who was able to establish a temporary laboratory early in the year at Butiaba on Lake Albert, in which Nile perch are the object of a large commercial fishery. The accommodation had to be evacuated in October owing to an exceptionally high rise in the level of Lake Albert which flooded the sand spit on which the store and laboratory

were erected. This officer had therefore to return to Headquarters at Jinja and continue with analysis of data already collected, and carry out further laboratory experiments on perch kept in controlled conditions.

Nevertheless the field work has established a great deal of hitherto unknown information on the breeding habits of perch, and the biology of the early stages. *Lates* appear to be demersal spawners, fry and eggs (the latter almost certainly being *Lates* eggs) being recorded near the bottom of the White Nile between Lake Rubi and Rhino Camp in April in flowing water. In the main Lake Albert, very small fry have been located near the bottom in water not more than 15 ft. deep in August, but trapping of fry and fingerlings and analysis of length frequencies indicate that breeding must occur in the Lake throughout many months of the year if not all.

Lates of all sizes are present in the Butiaba Harbour area for most if not all of the year, and it seems possible that in this lacustrine environment, the pattern of breeding seasons is probably different from that in the riverine environment. On the other hand, fry and small fingerlings have also been recorded in deep water up to 130 ft. and it is possible that these may have been carried to this deep area by currents from the shallow water in which they were spawned.

Fish up to 40 cm. show more dependence on *Caridina* prawns as food than was at first supposed, and *Lates* is only primarily piscivorous when more than 10 lb. in weight; but whether *Lates* can exist on prawns alone for a prolonged time is not known. The prey of *Lates* is now known to comprise many other kinds of fish as a result of examination of more stomachs, and this fish will in fact take any animal which conforms with the prey behaviour pattern described in last year's report.

Experiments are still in progress in ponds at Sagana to determine the impact of predation of *Lates* of known size on known populations of *Tilapia*, and figures have been obtained for such a relationship. It does not appear that in fact *Lates* has a marked effect on growth of surviving *Tilapia*, but in trying to establish such a predator/prey balance there are a great many natural variables to be considered which are of the utmost importance, and it cannot be said that the mere introduction of *Lates* into an overstocked pond will have the desired effect of increasing the yield of large size *Tilapia*. The problem is exceedingly complex and cannot be solved so simply.

Breeding Studies on *Tilapia zillii* and *Tilapia nigra*

These are the two species of *Tilapia* which are widely used in East Africa for pond culture work. *T. zillii* is a "guarder", or substratum spawner, which lays several thousand eggs at a brood, the parent fish standing guard over the eggs, which adhere in strings to a hard substrate, and over the shoals of fry which hatch from them. The adult fish are very largely feeders on macrophytic vegetation, and their ability to crop down many types of submerged and emergent pond vegetation is well known; it is for this reason they have been introduced into Lake Victoria in the hope that they will clear much of the fringing swamp vegetation where established.

T. nigra is a mouth-brooder, the few hundred eggs being taken into the female's mouth as soon as laid, and incubated there until hatched; the alevins or fry remain in the female's mouth until about the 17th day after laying, and the fry are then released periodically to feed themselves, being taken back into the female's mouth when disturbed, and at night time. This species is primarily a bottom grazer, and shows a marked sexual dimorphism in growth which renders it a very suitable subject for monosex culture, the males growing much larger than the females and growing markedly well in sexual isolation even after maturity.

As was described in last year's Annual Report, the breeding behaviour of *T. zillii* has been studied by Mr. Elder; and brood size, frequency of breeding, survival and growth of fry, by Mr. Cridland. The successful establishment of breeding pairs of *T. nigra* in aquaria at Jinja has now enabled Mr. Cridland to amass a great deal of data on the spawning behaviour, fecundity and frequency of breeding of this species as well, all of which has hitherto been completely unknown.

All this breeding data now raises a great many questions of interest, mainly on the aspects of physiological control of spawning, and the effect of the various stages of pre- and post-spawning behaviour, on the stimulation or inhibition of final ovulation. To be able deliberately to control the spawning periodicity of any *Tilapia,* in order to reduce the frequency of breeding, would be a major breakthrough in the use of these fish for cultural purposes. It does not appear impossible, and a Nuffield grant for two years to E.A.F.F.R.O. has enabled the appointment of an officer to commence such studies early in 1962. Factors affecting fry survival and biology will also be examined.

Equivalent data have now also been collected for pairs of *T. zillii.*

The Culture of *Tilapia* in Ponds

During the year, Dr. van Someren has continued studies on the culture of *T. nigra* in ponds at Sagana, being ably assisted in this by the Chief Fisheries Officer, Kenya, and the resident Fishery Officer at Sagana.

While monosex culture, using males only, undoubtedly gives high yields of uniformly large sized fish, the problem of management of the overstocked dam in which breeding has occurred, resulting in a runted population, remains acute. It has already been shown that the removal of a large quantity of fingerlings at regular intervals by netting will so decrease the biomass of the fish present as to allow of enhanced growth of survivors. But netting is a laborious technique, requiring capital equipment and labour, hence experiments have been directed to cropping of fry by traps which are selective for fry only. Such traps require little attention and can be operated by one man, but although experiments are still in progress, the various trapping methods so far tried have not succeeded in removing fry in quantities sufficient to make any significant difference to the growth of survivors, since it appears more difficult to trap fry than adult fish, for reasons not yet fully known; the fry show a great deal of trap avoidance which is not evident in large fish, and the latter can in fact be decimated at an astonishingly high rate by the use of vertical opening traps.

Experiments on the growth of separated male *T. nigra,* and thus on population of a known density, held in a pond subdivided into various sized compartments by wire netting barriers, have shown that the growth of these is very sensitive to the area of bottom available per unit fish and not to the total water volume which surrounds the fish. Since *T. nigra* is primarily a grazer, the results, although not unexpected, are of considerable interest.

Migration of River Fish

For four years an inclined grid trap has been operated on the small Ragati River at Sagana and Dr. van Someren has now analysed the fish migration records through this trap in relation to the daily hydrological observations on the river itself. These have shown the very high yields of katadromous fish such as eels, fish which are of high nutritive value, which can be obtained even by an inefficient trap on such a small river. The times of migration of these, and of *Labeo cylindricus,* are intimately related to the flood cycles and concurrent hydrological phenomena, though eels and *Labeo* show different migration patterns relative to

each other. All *Labeo* and *Barbus* passing the trap in each direction have been tagged with silver wire and plastic tags, and though returns have been small they have shown a somewhat random pattern of movement; and analysis of the recapture data has shown a very slow growth rate in *Labeo* but a faster growth in *Barbus tanensis*. The results are being written up for publication.

Hydrology and Algology

Dr. and Mrs. J. F. Talling completed a 12 months' survey of hydrological and algological phenomena at the E.A.F.F.R.O. Open Lake Station south of Buvuma Island in Lake Victoria. These have shown that stratified conditions developed gradually in the Lake between August and November and continued with a sharp and deep thermal discontinuity till June, when the Lake waters again became mixed. Phytoplankton density reached its minimum at the time of maximum discontinuity, but increased again after the mixed state supervened in July, although phosphates and nitrates showed little increase. Throughout the year nitrate was the nutrient most conspicuously in low concentration.

Low oxygen values below the thermal discontinuity were rarely maintained, and evidence was obtained of a horizontal variation of thermal structure in May, suggesting that an indirect communication between the bottom layers and the atmosphere may occur through horizontal water movements coupled with tilting.

The cyclical abundance of various phytoplanktonic algae has been followed through the year, and while marked seasonal changes of temperature and illumination cannot be direct causes of the cyclical variations found, there may be connexions with seasonal rainfall and the extent of vertical and horizontal water movements. The seasonal cycle of *Melosira* in particular, may be caused by a redistribution of this diatom from shallow marginal areas rather than by vertical water movements.

Estimations of photosynthetic productivity have so far not shown any very unproductive season and the average areal productivity has been maintained at values several times greater than the highest measured for spring diatom mazima in English lakes.

The importance of seasonal algal studies to such phytoplankton feeders as the *Tilapia*, and the effect of thermal stratification and oxygen level variabilities to bottom dwellers such as *Bagrus* and *Lates*, cannot be overemphasized, for on them may depend much of the success or failure of local fisheries apart from predation by man; the fish themselves are sensitive to the environment in which they live and cyclical changes of the nature found by Dr. and Mrs. Talling may markedly influence migration or survival. This is axiomatic for the basic study of any fishery or fish population, and far too little is yet known about this. Hydrological work on Victoria and other lakes has been distressingly discontinuous over the past years and these studies have pin-pointed the necessity for full time study of the continuance of these fundamental phenomena, particularly on a synoptic basis.

Gear Research

No final decision was taken during the year concerning the new vessel, and it was not possible to do any of the work required on ring-netting and trawling, etc., which is still required, both for fish population analysis and economic development.

Two aspects of minor gear research have been undertaken, the results of which are probably of major importance all over tropical Africa where gill net fishing is standard practice.

Buoy Releases.—During the latter part of 1960 and the earlier part of 1961, theft of our own experimental nets set nightly in the vicinity of Jinja in the Napoleon Gulf, reached alarming proportions, over £150-worth of nets being stolen at night with little or no chance of recovery owing to local social conditions, even with marked nets.

Gill nets are nearly always set on the bottom, with indicator buoys at the surface at intervals along the fleet, attached by ropes to the weighted nets. It is these buoys which give the net position away, making theft all too easy. In fact on one occasion when one end of a set net was being lifted late at night to mark fish, it was found that the other end was at the same time also being lifted and loaded into a canoe of thieves in the darkness!

Therefore if these indicator buoys could also be sunk at the time of setting, to be released again to the surface just about dawn after a predetermined interval, the position of the nets would then be completely hidden from potential thieves. Some form of mechanical or soluble link holding a bight in the buoy rope would achieve this, the link fracturing after a set interval, releasing the bight and allowing the floats to surface.

Mr. E. L. Hamblyn studied this problem and after trial of numerous devices, evolved a soluble link of a gelatin/glycerine mixture which dissolved slowly in water and fractured under load after some hours. This was by far the most promising approach, but could not be developed further with the chemical resources at our disposal. The problem was therefore pursued in co-operation with the E.A. Industrial Research Organization, who finally found that squares of ordinary carpenters' glue 20 × 20 × 7 mm. in size with a 4 mm. central hole (through which link strings were passed to secure a bight in the buoy rope) would fracture after periods of 6-8 hours at the normal Victoria water temperatures. These were given trials by Mr. Roberts, using made-up or standard native ambatch floats in Victoria. Numerous settings without loss were then made, but it became apparent that (*a*) the fracture period was not long enough, and (*b*) there was considerable variability in fracture time according to the source of the glue, and probably its moisture content before use.

It is essential to produce articles of absolutely standard performance and hence the matter is again in the hands of E.A.I.R.O. who, together with Messrs. Bulleys Tanneries, are now concentrating on producing a standardized product of reliable performance, for marketing. These links, though expendable, must be extremely cheap to produce in quantity for local sale. Theft is common among the fishermen who are as dishonest among themselves over their own property as they are with ours, and they would readily use such theft prevention devices if cheap and reliable enough. Net thieving is prevalent all over Africa wherever gill nets are used, and the market would be wide and lucrative.

It cannot be emphasized too strongly however that fishery officers and others concerned must *not* use or market any glue which is locally available, until a standardized reliable product can be put on the market. There could be nothing worse than such a method being unreliable or going off at "half-cock" as far as African fishermen are concerned, and advice is being sought to protect the Organization's interest in the development of this device.

As an instructive sidelight however on what may happen, in the restricted waters of Napoleon Gulf, the fishermen have realized that they are being baffled somehow and after a time have taken to observing the area where the launch has been setting nets, then going there after dark and dredging for the concealed nets with a stone attached to a long rope—with unfortunately an occasional modicum of success.

VERTICAL GILL NETS

The standard practice for netting *Tilapia* is to set horizontal nets sunk to the bottom during the night. Surface nets, or daylight settings, are usually very unproductive. Nevertheless it is known that there is a changing pattern of vertical distribution of fish, which may vary seasonally. These movements are usually known in an intuitive fashion by indigenous fishermen, but in order to find out more about this phenomenon Mr. Roberts has been experimenting with gill nets hung vertically.

Nets were set in the late afternoon, lifted early in the morning, and the fish not removed until the nets were spread on shore and measurements taken.

The catches were poor, and there is no doubt that a standard gill net fished thus is not efficient, for the diamonds of the mesh are horizontal and not vertical; there was evidence from slime patches on the meshes that several fish had hit the net and failed to gill themselves with a mesh stretched thus.

Nevertheless, the use of this gear would be of great value to determine at which depths to set standard nets, and although catches will be small, continued use will give some indication over a period of time of the vertical distribution of commercial species.

E.A.F.F.R.O. Staff List as at 31st December, 1961

DIRECTOR

V. D. van Someren, M.B.E., B.Sc., Ph.D.

RESEARCH OFFICERS

C. C. Cridland, Dip. Ferm.
E. L. Hamblyn, B.Sc.
H. Y. Elder, B.Sc.
One Vacant

EXPERIMENTAL FISHERIES OFFICER

J. D. Roberts

SENIOR FIELD OFFICER

R. I. M. Baxter

SECRETARY (Part-time)

Mrs. E. D. Kemp

ACCOUNTING ASSISTANT

L. F. D'Costa

FOREMAN ARTISAN

Pragji Dossa Mesvania

List of Papers Published in 1961

FRYER, G. The Spermatophores of *Dolops ranarum* (Crustacea: Branchiura): their Structure, Formation and Transfer, *Quart. J. Micr. Sci., 101* (4), 56 (1960). p. 407-432.

CORBET, P. S. The Food of Non-Cichlid Fishes in the Lake Victoria Basin, with Remarks on their Evolution and Adaptation to Lacustrine Conditions. *Proc. Zool. Soc., Lond., 136* (1), (1961). p. 1-101.

VAN SOMEREN, V. D. and WHITEHEAD, P. J. The Culture of *Tilapia nigra* (Günther) in Ponds: Pt. V—The Effect of Progressive Alterations in Stocking Density on the Growth of Male *T. nigra*. *E. Afr. Agric. For. J., 26* (3) (1961).

EVANS, J. H. Growth of Lake Victoria Phytoplankton in Enriched Cultures. *Nature, 189,* 4762 (1961). p. 417.

BEAUCHAMP, R. S. A. East African Fisheries Research. *Corona, 13* (2) (1961).

VAN SOMEREN, V. D. and WHITEHEAD, P. J. The Culture of *Tilapia nigra* (Günther) in Ponds: Pt. VI—The Effect of Selective Cropping Methods on Breeding Populations. *E. Afr. Agric. For. J., 26* (4), (1961).

VAN SOMEREN, V. D. Seasonal Flood Fisheries in Kenya Colony. *CCTA/CSA Hydrobiology and Inland Fisheries 4th Symposium,* May, (1961).

GARROD, D. J. The need for Research on the Population Dynamics of Tropical Species, with special reference to "Ningu" (*Labeo victorianus*) from Lake Victoria. *CCTA/CSA Hydrobiology and Inland Fisheries 4th Symposium,* May, (1961).

GARROD, D. J. The Application of a Method for the Estimation of Growth Parameters from Tagging Data at Unequal Time Intervals. *N. Atlantic Fish Marketing Symposium,* May, (1961) *851,* No. 41.

TJONNELAND, A. Light Trap Catches of *Neoperla spio* (Newman) (Insecta, Plecoptera) at Jinja, Uganda. *Contr. Fac. Sci. Univ. Addis Ababa.* Ser. C. (Zool), No. 1, (1961).

VAN SOMEREN, V. D. and WHITEHEAD, P. J. The Culture of *Tilapia nigra* (Günther) in Ponds: Pt. VII—Survival and Growth of Tagged and Untagged Males of Different Sizes. *E. Afr. Agric. For. J., 27* (1), (1961).

FRYER, G. The Parasitic Copepoda and Branchiura of the Fishes of Lake Victoria and the Victoria Nile. *Proc. Zool. Soc., Lond., 137* (1), (1961), p. 41-60.

FRYER, G. Larval development in the Genus *Chonopeltis* (Crustacea: Branchiura). *Proc. Zool. Soc., Lond., 137* (1), (1961), p. 61-69.

ELDER, H. Y. and GARROD, D. J. A Natural Hybrid of *Tilapia nigra* and *Tilapia leucosticta* from Lake Naivasha, Kenya Colony. *Nature, 191,* 4789 (1961), p. 722-724.

EVANS, J. H. A Phytoplankton Multi-Sampler and its Uses in Lake Victoria. *Nature, 191,* 4783 (1961), p. 53-55.

FRYER, G. Variation and Systematic Problems in a Group of Lernaeid Copepods. *Crustaceana, 2* (4), (1961), p. 275-285.

COTT, H. B. Scientific Results of an Inquiry into the Ecology and Economic Status of the Nile Crocodile (*Crocodilus niloticus*) in Uganda and Northern Rhodesia. *Trans. Zool. Soc. Lond., 29* (4), (1961).

FRYER, G. The Developmental History of *Mutela bourguignati* (Ancey) *Bourguignat* (Mullusca: Bivalvia). *Phil. Trans. R. Soc., Lond.* Ser. B. 711, *244,* (1961), p. 259-298.

GARROD, D. J. Some Effects of Changes in Mesh Legislation upon the Fishing Industry of Lake Victoria. *3rd Symposium Hydrobiology and Inland Fisheries Problems of Major Lakes,* Lusaka (1960). CCTA/CSA No. 63.

GARROD, D. J. The Rational Exploitation of the *Tilapia esculenta* stock of the North Buvuma Island Area, Lake Victoria. *E. Afr. Agric. For. J., 27* (2), (1961), p. 69-76.

GARROD, D. J. History of the Fishing Industry of Lake Victoria in Relation to Expansion of Marketing Facilities. *E. Afr. Agric. For. J., 27* (2), (1961), p. 95-99.

FRYER, G. Observations on the Biology of the Cichlid Fish *Tilapia variabilis* Boulenger in the Northern Waters of Lake Victoria (East Africa). *Rev. Zool. Bot. Afr., 64* (1-2), (1961).

EAST AFRICAN MARINE FISHERIES RESEARCH ORGANIZATION

DIRECTOR—D. N. F. HALL, B.Sc.

Owing to the failure of both research craft, the year 1961 has seen less field activity than any since the inception of the Organization. However, laboratory activity has been reciprocally high and the opportunity has been taken to collocate much of the data which had been accumulating.

STAFF

Mr. D. N. F. Hall was absent from Zanzibar on long leave in the United Kingdom from 10th June until 3rd September. On 1st December Mr. Hall was promoted to Senior Principal Scientific Officer.

Mr. B. E. Bell left Zanzibar for the United Kingdom on long leave on 2nd July. He is due to return to Zanzibar on 8th January, 1962.

Dr. J. F. C. Morgans left Zanzibar for South Africa on long leave on 13th September. On the completion of his leave Dr. Morgans will not be returning to Zanzibar, but will take up a lectureship at Christchurch, New Zealand.

The Relief Master of the r.v. *Manihine*, Commander I. P. Stevenson, left the ship to return to the United Kingdom on 30th March. As Captain A. Slater's agreement has not been renewed, the vessel was left in the care of the Mate, Mr. R. Houareau, who coped ably.

In preparation for more extensive and intensive oceanic operations, a completely new officer complement for r.v. *Manihine* is being recruited.

Mr. M. Y. Lodhi, Laboratory Assistant, resigned from the staff on 29th April, 1961, being replaced on 1st June by Mr. Parwan Singh. Both Laboratory Assistants are now engaged on Probationary Terms for permanent appointment.

MEETINGS, CONFERENCES AND COURSES

The Director attended the 15th and 16th Meetings of the East African Agricultural and Fisheries Research Council held at Muguga, Nairobi, on 13th January and 26th September respectively, and the 14th Meeting of the East African Marine Fisheries Research Co-ordinating Committee held at Dar es Salaam on 23rd November.

In preparation for his more important role, the hydrologist (Mr. B. E. Bell) attended a course in Copenhagen on the Carbon-14 technique for the estimation of primary productivity, and in London on radar observation. Mr. Bell is the second research officer to be trained in radar observation, Mr. Williams having attended a similar course in 1960.

BUILDINGS AND INSTALLATIONS

Two of the staff houses at Mazizini were equipped with fans during the year.

On 23rd December financial approval was received to build two more staff houses, bringing the total to seven. Plots have been earmarked at Mazizini.

VESSELS

In 1960 the Research Vessel *Manihine* steamed more miles on scientific investigations than in any previous year, over 10,000, but, particularly in the latter half of the year, the condition of the 10-year-old main engines caused much concern. The vessel was taken out of action in January, 1961, in order that a

comprehensive examination could be undertaken by a Lloyd's Surveyor (Mombasa). This survey showed that, while the engines were certainly in need of considerable attention, they were not irreparable, although the cost would be high.

Approval to go ahead with the engine repairs was received on 23rd December, 1961, and concurrently with these repairs a number of alterations and additions to the vessel will be carried out. A new radio incorporating a direction finding loop aerial, a sensitive echosounder, and a larger hydrographic winch are to be fitted, and radar is to be installed. The casing of the trawl winch engine, which at present occupies approximately one-third of the main laboratory space and greatly interferes with the scientific work on the vessel, is to be replaced by a much smaller tailor-made structure, while a re-arrangement of the bathroom and adjacent accommodation will enable a separate hydrographic laboratory to be constructed, and the accommodation to be equipped with the air conditioning so essential to the satisfactory operation of the complex electronic equipment which is on order.

The Organization is pleased to acknowledge that the Rockefeller Foundation has made a generous grant of $10,000 for the purchase of this hydrological equipment.

These modifications will not take longer than the main engine repairs, which, it is considered, will require four months. *Manihine* should be operational and tested well before 6th August, the date on which the first extended cruise in connexion with the International Indian Ocean Expedition is scheduled to start.

Following the extensive overhaul in 1960, the Research Launch *Chermin* did not operate as well as had been anticipated. Although 800 miles were steamed in 1961, compared with 565 in 1960, five of the eight cruises ended prematurely. The launch was finally taken out of action during the last week of August, and from 26th September until the end of the year it was on the Port and Marine slip, Zanzibar.

During the 1960 overhaul, several frames in the stern half of the *Chermin* had to be replaced as they were badly cracked. During 1961, further extensive cracking took place, mainly of the forward frames. This allowed considerable leakage through the planking which resulted in various mechanical and electrical faults.

The *Chermin* was built for day-to-day operations in the relatively calm waters of Singapore Strait, where it operated successfully for two years. Following the closure of the Singapore Regional Fisheries Research Station in 1957 the launch was shipped to Zanzibar where it has been called upon to undertake lengthy safaris, frequently in rough weather.

The basic cause of the hull defects which have arisen in the past two years is without doubt that the structure of the launch is fundamentally too light for the operations now demanded of it, possibly aggravated by an unsound engine mounting.

To rectify completely these defects may be impossible, but the launch is now completely reframed, replanked in part, and the engine has been remounted in order to distribute more widely the out-of-balance forces. It is expected that the launch will be in operation again before the end of January, 1962.

International Indian Ocean Expedition

At its meeting on 13th January, 1961, the East African Agricultural and Fisheries Research Council formally approved the participation of the Organization in the Expedition, to which more than 40 ships and over two dozen countries and territories are now committed, and plans are now well advanced.

R.V. *Manihine* will be undertaking two extended cruises which will take the vessel east to the Seychelles and north to Aden. Each cruise will have a duration of about two months and in each cruise the vessel will steam approximately 7,500 miles. The provisional dates are 6th August-6th October, 1962, and 14th January-16th March, 1963.

Four scientists will man the research vessel during each cruise, the staff of the Organization being supplemented by scientists from the United Kingdom.

In order to accommodate the permanent staff more effectively—the laboratory in Zanzibar has for some time been inadequate—and to accommodate the visiting scientists, plans are in hand to build extensions to the existing structure which will more than double its floor area and greatly increase its facilities. The completed building will include an open-circuit seawater circulation system with 22 specimen tanks ranging in size from 2 ft. × 1 ft. × 6 in. to approximately 28 ft. × 6 ft. × 6 ft., together with a double-storey net store, and improved dark room, library and laboratory facilities.

During the extended cruises, the Organization will be particularly interested to study the Somalia Current from both the scientific and fisheries viewpoints, as it is believed to be considerably richer than the East African Coastal Current, yet still within range of medium-sized modern craft operating from East Africa.

Scientific Investigations

A. Pelagic Fish

1. *Deep Longline Investigations* (Mr. F. Williams).

Mr. Williams attended the International Billfish Competition held at Malindi from 8th to 10th February, but apart from this, in the absence of a research vessel, no field work has been possible in this investigation.

Mr. Williams has prepared a contribution to the "Symposium on Scombroid Fishes of the Indian Ocean" which is to be held at Mandapam Camp, India, on 12th-15th January (1962). The paper deals with the tuna, billfish and seerfish (Kingfish) of East Africa and contains much data hitherto unpublished.

Following a recommendation made at the Dakar Tuna Symposium in December, 1960, Mr. Williams is collaborating with Dr. F. H. Talbot (South African Museum) in an investigation of the status of the Indian Ocean bonito (*Euthynnus affinis*).

Whilst he is on leave, Mr. Williams will attend the F.A.O. World Meeting on Tuna to be held at La Jolla, California, from 2nd to 16th July, 1962. For this meeting, Mr. Williams has been asked to prepare synopses of existing knowledge on the Indian Ocean bonito and on the frigate mackerel (*Auxis thazard*) of the Indian Ocean, and also to present a paper on the present state of tuna investigations in East Africa.

Studies on the race of the Indo-West-Pacific striped marlin (*Tetrapterus audax*) found in East African waters are being carried out in conjunction with the Ministry of Agriculture, Fisheries and Food Laboratory, Lowestoft.

Data on the catch and effort of sailfish (*Istiophorus gladius*) are now complete for three seasons (July, 1958-June, 1961) of the Malindi sport fishery, together with a quantity of morphometric details. This information is being processed.

In order to determine the migratory routes, the location of the large predatory fish, such as the tuna, marlin, swordfish and sailfish, when they are apparently absent from East African waters, and the age and growth-rates of these fish, a programme of fish-tagging is about to be launched. American tuna tags, serially numbered and printed with the Organization's name and address, have been obtained for the purpose. Each tag consists of a bright yellow polythene tube, about 5 in. in length, bearing at one end a barbed point. The pointed end is thrust into the dorsal muscle of the fish by means of a large hypodermic needle, leaving about 3 in. of the yellow tube protruding from the body, and easily visible.

20,000 descriptive leaflets are being printed initially in English, French, Swahili and Arabic, in order that all fishermen in the western Indian Ocean will be informed of the tagging programme. A reward of Sh. 20 is being offered for each tag which is returned to the Organization with information about the fish from which it was taken. Leaflets in other languages to cover the entire Indian Ocean will follow, as it is not unlikely that the fish will range over many hundreds of miles.

It is hoped that a start to the programme will be made in January, 1962, when, with the co-operation of the Malindi sport-fishing-boat owners, the first fish to be tagged will be sailfish.

Statistical analyses of data on Carangidae and Sphyraenidae collected between 1951 and 1960 are being carried out by the East African Statistical Department, and taxonomic studies on these two families, and in particular on the genus *Uraspis*, are in hand.

2. *Sardine Investigations*

During early 1961 a small but complete purse-seine team started operations from Dar es Salaam. The operations to date have been against sardines and other small fish which are attracted to bright lights. In March the team demonstrated that catches of about one ton per shot could be caught within three to four miles of Zanzibar city. The catch-rate has been of this order off Dar es Salaam too, and, as three or more shots can be made each night, the nightly catch has frequently been in excess of three tons.

The catches off Zanzibar in March were predominantly of sardines. Later in the year the catches off Dar es Salaam showed only about 25 per cent by weight of sardines, but the remaining fish were predominantly of valuable food species. The night-time purse-seine operations are expected to continue, and arrangements have been made for data and samples to be examined in the laboratory in order to determine the seasonal variations in the size of the catch and the catch composition, to determine the factors influencing the distribution of the fish, and to assess the potentialities of the fishery.

3. *Surface Shoaling Pelagic Fish*

Eight years ago E.A.M.F.R.O. first advocated the use of purse-seine gear for operations against the numerous surface shoals of tunny-like fish, that is small yellowfin tuna, skipjack and bonito. Now that a team having the very necessary expertise has started marine operations (at present against sardines), the Organization proposes to make the fullest use of these talents and base a pilot project on this equipment, aimed at an assessment of the potentialities of the shoals. Along a coast where the Continental Shelf, that is water less than 600 ft. deep, is virtually non-existent, only the pelagic fish can be expected to provide the necessary numbers on which a modern fishery can be based: off East Africa the surface shoaling tunny-like fish are considered to be by far the most likely basis for a modern fishery.

B. Demersal Fish

1. *The Fisheries of the North Kenya Coast* (Dr. J. F. C. Morgans).

In the absence of a research vessel Dr. Morgans was unable to study the outstanding problems of this investigation, namely (i) Confirmation that the south-east monsoon is unproductive due to the absence of fish and not to any other cause. (ii) The determination of the factors which govern the shoaling of the fish, and in particular, a further investigation of the "submarine island" hypothesis. (iii) The trial of approved commercial deep handlining gear and improved baits for comparison with that already in use. (iv) The extension of sampling to include the hours of darkness and the determination of the optimum fishing time.

The purport of the "submarine island" hypothesis is that the demersal populations dwelling above the thermocline, which includes all the most important species, are effectively isolated if they live on a knoll which projects above the thermocline. With variations in the depth of the thermocline occurring seasonally, daily and even hourly, the hypothesis may explain, at least in part, the considerable variations in the apparent concentration of the demersal fish populations: when the thermocline is deep there is room for foraging, while when it is high the fish are more crowded together.

The deep-sea reel which has been used extensively in the investigations to date was devised by Dr. Morgans for its simplicity and cheapness: it is a reel which can be produced in any local garage. It has none of the refinements of the American commercial reels, and it seems likely that the catch-rate on the North Kenya Banks could be increased if more elaborate gear were used.

The overall catch-rate of 10.8 lb./line-hour already compares favourably with rate in the Gulf of Mexico, yet this rate was produced from fishing over a wide range of conditions, and no attempt was made to confine activities to the better seasons or areas.

Before Dr. Morgans left Zanzibar on leave he completed six papers covering the work to date. Of these, three were important taxonomic papers, the East African Serranidae in particular being well considered, while a fourth paper dealt with the investigation from the fisheries aspect.

C. Inshore and Estuarine Fisheries

1. *Prawns* (*Penaeidae*). (Dr. A. J. Bruce.)

During the periods of activity of the *Chermin* in 1961, 171 trawl hauls were made for prawns (Penaeidae). Although, from a commercial viewpoint, no significant numbers of prawns were taken, this is not surprising as, owing to mechanical failures of the launch, none of the hauls was made during the recognized main prawn seasons for the areas concerned. A considerable amount of data was collected however, as a result of which it is considered that, in the continuation of this investigation, the launch should operate on detachment in the Mafia area for at least one year.

Small numbers of adults of two of the enigmatic East African species have now been located. Large numbers of juveniles of *Penaeus latisulcatus* are present all through the year on several Zanzibar beaches: adults have now been captured in shallow water at Mkokotoni, but only during night-time operations, while a few specimens have been taken from the southern Zanzibar Channel at 30 fm. A single adult specimen of *Penaeus teraoi* has been obtained from 100 fm. to the south of Zanzibar. This species is most probably the same as the juveniles, previously attributed to *Penaeus marginatus*, which have been found at the surface over a large area of deep water. Prior to this the species had been recorded only from Japan.

The receipt of a highly effective fish poison has made it possible to collect penaeid material from locations which would otherwise be unsampled, and during periods of inactivity of the *Chermin* it has proved a useful means of continuing the study.

Market samples too have been examined. These show a very high percentage of juvenile *Penaeus indicus* together with a few juveniles of *P. monodon* and *P. latisulcatus*.

2. *Lobsters (Palinuridae)*

Biological data from the commercial Zanzibar catches are now being collected by Dr. Bruce to complement the data on the fishing effort which is being received by the Organization. Of the five species known to occur, only three (*Panulirus ornatus, P. versicolor* and *P. longipes = japonicus*) have occurred in the biological samples, and all show a very high percentage of actively breeding females. A most important feature revealed by the examination is that almost all the large specimens consist of a single species (*P. ornatus*), whereas almost all the smaller specimens are adults of the smaller species *P. versicolor* and *P. longipes* with but few young *P. ornatus* in evidence. Biologically this is a sound basis for a commercial fishery provided there remains a reserve of breeding lobsters. To confirm this, a trapping programme to sample depths beyond the range of the skin divers is being introduced.

3. *Crustacean Taxonomy and Biology*

Dr. Bruce's examination of non-penaeid prawns and stomatopoda has continued. The total number of species of Decapoda Natantia and Stomatopoda recorded so far exceeds 180. By far the majority of these are new records for the western Indian Ocean and this work forms a most valuable contribution to carcinological knowledge. It is proposed that this aspect of Dr. Bruce's work be written up on his return from long leave (*c.* October, 1962), after he has been able to study type specimens in European collections.

A representative collection of marine Decapoda has been presented to the National Museum of Southern Rhodesia.

4. *Fish Stomach Contents*

Dr. Bruce has continued the examination of the crustacean component of the stomach contents of fish taken from the Deep Longline Investigations, and the North Kenya Banks. In the past three months this examination has been of considerable importance in Mr. Williams collocation of data on the large pelagic fish.

D. Plankton Investigations. (Mr. J. H. Wickstead—Visiting Worker.)

Mr. Wickstead was just able to complete a 12-month series of collections from the three selected permanent stations off Zanzibar before *Manihine* was finally withdrawn from service, but the transects of the East African coastal waters, from the shore-line to 70 miles out, and some of the specific problems, in particular the diurnal migrations of the East African Zooplankton, were not completed.

Mr. Wickstead left Zanzibar on 2nd May, and is now working up the material at the Laboratory of the Marine Biological Association of the United Kingdom, Plymouth. A complete report on the study is expected by early February (1962).

E. HYDROLOGICAL INVESTIGATIONS. (Mr. B. E. Bell.)

Mr. Bell's field activities in 1961 were limited necessarily to small boat activities. Two safaris were made, one on the *Ahsante Chole*, a powered mashua borrowed from the Fisheries Department, Tanganyika, while the *Chermin* was out of action, and one with Dr. Bruce on the *Chermin*. Both safaris were to the Pangani area, in order to continue the study of the salinity gradient in Pangani River, the current patterns in Pangani Bay, and the topography of the sea-bed of the Bay.

Before proceeding on leave in July, Mr. Bell completed the prototype of his unique triggering depth gauge. The principle of this gauge is the release of a predetermined volume of air from the closed end of a cylindrically poly-sigmoidal Kelvin tube: the volume of air remaining is a measure of the depth at which the instrument was actuated, and can be read (at the surface) on a linear scale. During his leave, Mr. Bell took out joint patent rights on the instrument with the National Research Development Corporation, and a trial production model was made. Manufacture of the gauge has been undertaken by a British firm of instrument makers, Casella Limited, and it is expected that the first production models will be despatched to Zanzibar shortly.

A description of the prototype gauge was prepared and accepted for publication in Deep-Sea Research, but as the production model differs somewhat from the prototype, the paper is being resubmitted.

Mr. Bell's depth gauge has a wide range of uses in situations where an accurate knowledge is required of the depth at which single operations take place. Initially E.A.M.F.R.O. proposes to use the gauge for determining the depth at which large pelagic fish, such as tuna and marlin, strike midwater hooks during deep long-line operations.

E.A.M.F.R.O. Staff List as at 31st December, 1961

DIRECTOR

D. N. F. Hall, B.Sc.

STAFF

F. Williams, M.Sc., Research Officer.
J. F. C. Morgans, M.A., Ph.D., Research Officer.
B. E. Bell, M.A., F.R.Met.S., Research Officer.
A. J. Bruce, B.Sc., M.B., B.S., Research Officer.
Mrs. L. A. M. Cameron, Secretary.
D. E. Coutinho, Financial Clerk.
Master, r.v. *Manihine*, (Vacant).

Papers Prepared for Publication or Published During the Year

BELL, B. E. Triggering Depth Gauge. (Submitted to *Deep-Sea Research*.)

HALL, D. N. F., 1961. The Malayan Penaeidae (Crustacea, Decapoda) Part II. Further taxonomic notes on the Malayan species. *Bull. Raffles, Mus.*, 26, 76-119.

MORGANS, J. F. C. Ecological Aspects of Demersal Tropical Fishes of Fisheries Value off East Africa. (Submitted to *Nature*.)

——A Simple and Cheap Design of Large Reel for Commercial Bottom Fishing in Deep Water. (Submitted to *E. Afri. agric. for. J.*)

——East African Fishes of the *Epinephelus tauvina* complex, with a description of a new species. (Submitted to *Ann. Mag. nat. Hist.*)

——A Preliminary Survey of Bottom Fishing on the North Kenya Banks. (Submitted to *Fish. Publ.*, London.)

——Serranid Fishes of Tropical East Africa. Part I. Keys to the Subfamilies, Genera and Species with Descriptions of Certain Species and Notes on their Biology. (Prepared for submission.)

——Serranid Fishes of Tropical East Africa. Part II. The Genera *Plectropomus*, *Promicrops* and *Epinephelus* with keys to the species and Notes on their Biology. (Prepared for submission.)

WHEELER, J. F. G., 1961. The Genus Lethrinus in the Western Indian Ocean. *Fish. Publ., 15*, London.

WICKSTEAD, J. H., 1961. Plankton on the North Kenya Banks. *Nature, 192*, 890-891.

WILLIAMS, F., 1961. On *Scomberomorus lineolatus* (C.V.) 1831 from British East African Waters (Pisces, Scombridae). *Ann. Mag. nat. Hist.* (13), *3*, 183-192.

——1961. On *Uraspis wakiyai sp. nov.* (Pisces, Carangidae) from the Western Indian Ocean with a review of the species *Uraspis* Bleeker 1855, *s.s. Ann. Mag. nat. Hist.* (13), *4*, 65-87.

——Scombroid Fishes in the Indian Ocean. (Manuscript prepared for Marine Biological Association of India Symposium.)

APPENDIX

Attendance at the Fifteenth, Sixteenth and Seventeenth Meetings of the Council

FIFTEENTH MEETING, 13TH JANUARY, 1961

Sir Ferdinand Cavendish-Bentinck, K.B.E., C.M.G., M.C.
Sir Edgeworth David, K.B.E., C.M.G.
Mr. B. R. McKenzie, D.S.O., D.F.C.
The Earl of Portsmouth.
Mr. P. Bomani.
Mr. A. B. Killick, C.M.G.
Mr. H. L. Manning.
Dr. E. G. Cox, T.D., F.R.S.
Sir Geoffrey Nye, K.C.M.G.

In Attendance

Professor W. E. Kershaw.
Mr. G. W. Thom.
Mr. W. E. Crosskill.
Mr. A. P. S. Forbes, C.B.E.
Mr. H. L. Adams, T.D.
Dr. H. C. Pereira.
Dr. E. W. Russell, C.M.G.
Mr. H. R. Binns, C.M.G., O.B.E.
Dr. V. D. van Someren, M.B.E.
Mr. D. N. F. Hall.
Dr. W. H. R. Lumsden.
Lt.-Col. S. P. Fearon, Secretary.

SIXTEENTH MEETING, 26TH SEPTEMBER, 1961

Sir Ferdinand Cavendish-Bentinck, K.B.E., C.M.G., M.C.
Sir Edgeworth David, K.B.E., C.M.G.
Mr. M. Blundell, M.B.E.
The Earl of Portsmouth.
Mr. T. S. Tewa.
Mr. F. R. J. Williams, O.B.E.
Mr. Juma Aley Abrawy.
Professor A. Robertson, M.A.
Mr. F. C. Bawden, F.R.S.

In Attendance

Professor A. C. Frazer, M.D., D.Sc.
Dr. E. G. Cox, T.D., F.R.S.
Professor M. Crawford, D.Sc.
Mr. K. D. S. MacOwan, C.B.E.
Dr. A. C. Evans, B.Sc.
Mr. R. G. Sangster.
Mr. M. F. H. Selby.
Dr. H. C. Pereira.
Mr. H. J. Hinchey, C.B.E.
Mr. H. L. Adams, C.M.G., T.D.
Dr. E. W. Russell, C.M.G.
Mr. H. R. Binns, C.M.G., O.B.E.
Dr. V. D. van Someren, M.B.E.
Mr. D. N. F. Hall.
Dr. W. H. R. Lumsden.
Mr. A. T. Davey, Secretary.

Sir Ferdinand Cavendish-Bentinck, K.B.E., C.M.G., M.C.
Sir Edgeworth David, K.B.E., C.M.G.
Sir Michael Blundell, K.B.E.
The Earl of Portsmouth.
Mr. P. Bomani.
Chief H. M. Lugusha, C.B.E.
Mr. B. J. Mukasa.
Mr. H. L. Manning.
Mr. M. F. H. Selby.
Mr. D. Rhind, O.B.E.

In Attendance

Mr. H. J. Hinchey, C.B.E.
Mr. H. L. Adams, C.M.G., T.D.
Mr. A. P. S. Forbes, C.B.E.
Mr. F. R. J. Williams, O.B.E.
Dr. H. C. Pereira.
Air Commodore E. L. Howard-Williams.
Dr. E. W. Russell, C.M.G.
Mr. H. R. Binns, C.M.G., O.B.E.
Dr. W. H. R. Lumsden.
Dr. V. D. van Someren, M.B.E.
Mr. D. N. F. Hall.
Lt.-Col. S. P. Fearon, Secretary.

G.P.K. 4429—500—3/62